Including Ham Radio Fun!

JANUARY 1997
ISSUE #436
USA $3.95
CANADA $4.95

International Edition

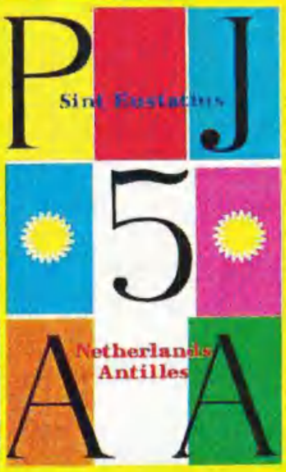
73® Amateur Radio Today

Automatic
Voltage
Controller

More CW fun
With this keyer

Soup up your Rx
With a preamp

73 Reviews:
WEFAX Demodulator



Build a ScopeMixer
The industrial-strength signal cleaner

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM (ok) or Mac (preferred) formats), carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

Including Ham Radio Fun!

JANUARY 1997
ISSUE #436

73® Amateur Radio Today

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

REVIEWS

HAM RADIO FUN SECTION

On the cover: Winning entries from *73's* "QSL of the Month" contest, June 1996 through January 1997. Winners for each month have received a free one-year subscription or extension.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: Have you tried microwaves? How about amateur television? When's the last time you home-brewed a piece of equipment? Reading this contract commits you to trying something new or long-neglected. The *73* advertisers can supply you with whatever you need ... just don't forget to tell 'em *73* sent you.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Resolutions

The beginning of the new year is a good time to make changes. The Christmas holidays wind up the old year, giving us a chance to make a fresh start with the new one. What changes are you going to make?

Yes, of course I have some recommendations. Hey, if you give me an inch, I'll try to revamp your whole life for you. For the better. Are you game to try some changes that will (a) Make you much healthier? (b) Happier? (c) Wealthier? (d) Do a better job with your kids? (e) Bring adventure into your life? (f) Accomplish something you'll be proud to be remembered for?

That's a tall order, but doable, unless your (bad) habit patterns are so thoroughly ingrained that you are no longer even capable of change.

Let's start with adventure, since that's closest to home, hamwise. Pick something you haven't done yet, but which sounds like fun, and get cracking. It could be slow-scan, RTTY, packet, 6m, 10 GHz, the ham satellites, or even 160m. Read, ask questions, start setting up the gear, and learn. I hope you'll keep careful notes so you can help others avoid the pitfalls and blind alleys. Maybe I can even get you to do some articles for *73*? If I can just get you started, I guarantee you'll be in for adventure.

Take 6 meters for instance. When the band was opened after WWII, I didn't think much about it. I was busy having fun up on 10m and 2m. Then one day I turned on my old pre-war Meissner FM tuner. The FM broadcast band, as I recall, used to be at 50-56 MHz, with the 5m ham band from 56-60 MHz. Suddenly I was hearing a whole bunch of S-9 W6s and W7s pouring through. Well, it didn't take long for me to convert an SCR-522 transmitter to 6m and build a converter for my SX-28. As far as I know, I was the first station on 6m in New York City and I had a ball.

In those days everyone was crystal-controlled, so with my surplus frequency meter I could tell who was who locally just by checking the frequency. There was a scattering of hams around Northern New Jersey, Long Island, upstate New York, and Connecticut.

To help other hams find out when the band was open I set my rig up on 50.1 MHz with a code wheel keying it as a beacon. That attracted Perry Ferrell, who had a contract with the Air Force to investigate the propagation characteristics of the band. I got a nice Radio Amateur Scientific Observations (RASO) certificate from the Air Force for my participation.

Later, when Perry became the editor of *CQ*, this helped me get him interested in my RTTY work. And that led to my doing a RTTY column in *CQ*, which led to my getting Perry the job as editor of *Popular Electronics*. And that led to my becoming the editor of *CQ*. And *that* led to my starting *73*.

But then, every new thing I've done in amateur radio has led to some sort of adventure for me, so I hope you won't get fed up with me prodding you to try new modes and bands. I get so discouraged when I listen to 75m nets and 20m round tables, where it is obvious that everyone is just marking time with their lives until the Silent Key guy comes calling. How is that better than watching ball games or sitting in bars? It's like going to a gourmet feast and eating a hamburger.

I've written about health, wealth, and happiness before. Should I keep repeating myself? A good part of happiness is in your family. So how much attention are you paying to romance? While a new rig may really get *your* juices going, your wife will be far more responsive to romance. And don't you forget it.

One of the easiest ways to rekindle romance is with dancing. Yes, I know, you're a klutz and would rather turn off your linear and run barefoot than go dancing. So get one of Sherry's how-to-dance videos and see what happens. You could use the romance and Sherry can use the extra business. Call 800-43-DANCE for a catalog.

What will it take to get you to make the big health change for '97? With daily exercise, a healthy diet, stopping poisoning your body, drinking enough water, and stuff like that? No chance, eh? Well, 1997 is going to be whatever you make it, and the new year is a fine time to make the big changes in your life that will see you living healthier, happier, and wealthier. Or not. You can make my year for me by letting me know that I've helped you decide to make changes. Will I be getting a note from you, or perhaps a handshake and some encouragement at a hamfest?

I haven't been invited to the '97 HamVention yet, but perhaps I'll see you there in '98? A new, trim, slim, grinning you?

I got a letter recently from a reader who thanked me for pushing him many years ago to start his own electronics-oriented business. His company is now one of the top in the field and he's having the time of his life.

The Camel's Nose

As if we don't have enough trouble with the FCC slicing off chunks of our unused ham bands, now Congress is forcing the FCC to hack away at us. Yes, of course our ARRL ham lobby in Washington should have prevented this. But I'm not sure we have even a vestibule there, much less a lobby.

Congress, a collection of politicians (mostly lawyers) you keep re-electing, can smell money through 10 feet of lead. And their main purpose in getting elected seems to be to spend as much of your money as they can, including borrowing as much as possible from the future. So the aroma from the recent FCC spectrum auction made Congress impatient with the FCC's slowness in generating more money for their pork futures.

Just before going home for the holidays, Congress whipped through Public Law 104-208, and it was signed by Clinton Oct. 4th. This little baby slices off two 5 MHz chunks of our 13 cm band to be put up for auction. Slice and dice.

I know you won't forgive me for going back in time 30 years. That's when the ARRL stopped our ham growth dead and almost totally destroyed our American ham industry, wiping out about 90% of our ham dealers as well. But if this catastrophe had not happened—if amateur radio had been permitted to continue growing as it had steadily in the previous 17 years—today we'd have over 5 million hams, and our country would have over 4 million more technicians, engineers and scientists than it does now. And I don't think we'd have either unused microwave ham bands or any problem with Congress and the FCC slowly putting what's left of us out of our miseries.

I don't think we would have lost all of our consumer electronics industries to Japan either.

Where have the kids all gone? They're rushing to the Internet, where you'll find endless teenagers having a ball with chat rooms instead of chasing DX or gabbing on 75m. Or getting on our ham satellites with packet.

If an ARRL director were to come to you, wringing his hands, asking what, oh what, can be done about this, what would you say?

I'll give you a hint. There are two things I can think of that the League could do to start turning this situation around. No,

Continued on page 7

LETTERS

From the Ham Shack

Neil V. Friend W2AMY. Thank you for printing WA8YKN's article on "free energy" devices which appeared in the September issue. Having read several articles on "zero-point" energy without the term being defined, I found his explanation enlightening.

Concerning the discussion of the "N" machine, however, I submit that the machine follows known laws of electrical power generation by mechanical-magnetic means and draws no power from "N space" or other sources. Any voltage or current generated is strictly the result of relative motion between a conductor and a magnetic field as occurs in any generator or alternator (read your *ARRL Handbook*). I also submit that the magnetic field does rotate as one with the magnetic cylinder, in spite of Tesla's reported conclusion that it remains stationary (a point discussed later).

Anyone determined to construct a copy of DePalma's machine would be well advised to first build an inexpensive small-scale version, as I did, for testing after considering the following discussion.

In this discussion, it is assumed that the copper disc, shaft and magnets shown in **Fig. 3** of WA8YKN's article all rotate as a single unit and the disc is electrically connected to the shaft. Observe that in **Fig. 3** of the article the magnet flux (not shown) surrounds the entire cylinder, while becoming weaker with distance from the cylinder. This is basic magnetic theory.

Again referring to **Fig. 3**, note that the brush (and part of its lead closest to the brush) in contact with the copper disc is bathed in the outer magnetic flux from the cylinder. The brush and its lead are stationary while the magnetic field rotates so that there is relative motion between them, which induces a voltage in the brush and that part of its lead within the field. The induced voltage will depend on the speed of rotation and flux density but, due to the limited exposure to the field, the voltage will be low. *This is the sole source of any power generated by this machine* as evidenced by the observations. If the copper disc is replaced by one of significantly greater diameter, the brush and lead will be isolated from the rotating magnetic field with a consequent reduction or elimination of generated power.

Going back to the smaller copper disc, we can relocate the brush to a slip ring mounted on and insulated from the shaft and well out of the magnetic field. Restore the circuit by soldering a jumper wire between the outer edge of the copper disc and the slip ring. Once again, with this brush and its lead now isolated from the rotating magnetic field, the power generated will be zero.

I have verified the above with the help of a fractional horsepower DC motor, four 1.12" diameter ring magnets and some lathe work. Measured output at 2,300 rpm while using a 1.2" diameter brass disc was 2.75 mV open circuit and 1.6 mA short-circuit current. With a 1.5" diameter brass disc or the slip ring version there was no detectable output.

WA8YKN also notes that rotating the magnet alone produced no voltage in a stationary disc and caused Tesla to conclude that the field did not rotate with the magnet. This conclusion is unreasonable if one considers a cylindrical magnet that has a non-uniform field. It appears to absurd to imagine that the non-uniform field would remain non-uniform and stationary while the source of this field rotated.

WA8YKN cites a DePalma test which produced 1.05 volts at 7,200 amps, but it is not stated whether this was an open circuit voltage and short-circuit (no load resistor) current. Such a high current would be expected in a short circuit fed by the interaction with an intense magnetic field rotating at high rpm. Both current and voltage can be expected to drop dramatically if measured with a suitable load on the output.

I have a copy of a data sheet on another DePalma test which shows 1.872 volts and 3.492 amperes, which they multiplied together to get an output of 6.538 watts. From the data sheet it is obvious that these are open-circuit voltage and short-circuit current readings and the computed output is therefore meaningless (again, read your *ARRL Handbook*).

With this machine all may not be as it at first seems and your efforts may be better expended on some other device.

Spoilsport... Wayne.

Warren Rudolph W4OHM. Wayne, you wondered how many still have the October 1960 37¢ issue. I have every issue from #1 to now, all in binders. I was licensed W4OHM after WWII and have held the same call ever since. I am a chartered member of the Shenandoah Valley Amateur Radio Club and obtained my first class commercial license and radar endorsement. I've also written articles which have been published in several radio magazines. I went on the Winchester police force in 1942 as a dispatcher and retired as Chief of Police in 1980 with the rank of major. I am presently active on 10 and 2 meters and am an active member of the local radio club.

Don Walters WA8FCA. Re your August editorial and keeping our 144, 220, and 420 MHz bands: Perhaps we should pitch to the potential buyers that we need at least a couple of MHz for amateur radio because it provides a "hands-on" training ground for and a place where future technicians and engineers can develop an interest in communications and electronics, something they do not get in trade schools and colleges. And regarding the sale of the spectrum, I believe that it should be leased for a period of time with the lessee paying an initial fee which is the highest bid and then a yearly lease payment based on a percentage of what they paid initially for the term of the lease. This provides a continuing revenue stream to the government for a public resource being used for commercial and private gain. Why? Because the spectrum is a national resource that should be kept publicly held while generating an initial and a continuing revenue stream for the private use of this public resource. *(1)*

I have been a ham since 1962 and have learned much from it that has provided countless hours of fun and learning, as well as provided a training ground for learning some marketable job skills that have enabled me to always find a job. But just as mainframe computer programmers are dinosaurs, nearly having outlived their usefulness, could it be that amateur radio has also outlived its usefulness? I hope not. If not then we must redefine amateur radio and what benefit to our society/country it can/does provide and then let our society and country know!

Detroit radio station WJR is now airing Art Bell's show. It's a little too late at night for me to listen to it, but I might start taping it.

When is *73* going to get an E-mail address for letters and perhaps sending manuscripts for articles? *(2)*

Amateur radio/computer swap and shops do not advertise as much as they used to. I remember the local swap and shops always being crowded and people knowing about them substantially before their date. But not these days. There is just not the same level of advertisement and promotion that there used to be. *(3)*

I have a younger brother whose past lifestyle may now be causing him medical problems. He is not HIV positive, but appears to be sick too often with viral infections and the like. I am seriously thinking of building the Bioelectrifier circuit to see if it will help him. If I do build one I will let you know if the results are promising or not. *(4)*

Keep up the *great* work, rattle those chains, keep pushing us all to do something, keep the editorials interesting and mind expanding. Perhaps it might just get enough, or at least some, people moving!

Hmm. Don, on (1), for some leaping liberal reason you are expecting corporations to actually consider the future. It doesn't happen with people, corporations or politicians. Get real. (2) Now and then I look to see what has accumulated at Design73@AOL.com. (3) Ham radio, as well as our hamfests, has sunk below the public awareness horizon. When will clubs and hamfest organizers get live PR persons? I got a hamfest announcement for a Detroit October hamfest a week after my October 73 came. (4) The bio-e won't hurt and could work wonders for your errant brother. Lemeno... Wayne.

NEVER SAY DIE

Continued from page 4

they're not doing either one. Instead they're passing the hat, asking for more money.

But, let's see what you come up with. How's your creativity doing?

ARRL Worried

I've been getting form letters from the League confirming that they are, at long last, starting to worry about the potential loss of ham bands which I've been gloom-and-dooming about in my editorials for a couple of years or so. Naturally they've used this as an excuse to rattle their tin cup, begging for donations. Hey guys, you're a multi-million-dollar publishing enterprise. If you need more money for something, raise the subscription price for *QST*.

As far as donating money for the protection of our frequencies is concerned, it seems to me that I remember money being set aside for that before. $100,000 comes to mind. Of course, I'm getting old now and maybe my memory isn't as good as it used to be, but I seem to remember visiting the lavish League hotel suite in Geneva's most expensive hotel during an ITU conference, and the flying over of directors for parties, all at the members' expense. And hey, wasn't there something about a League president who vacationed away a big bunch of that frequency-saving money with a girlfriend in the Caribbean? Golly, what was his name? I forget if I ever wrote about that or not.

The League letters confirm that there really is a major problem—that our UHF ham bands in particular are in serious jeopardy. As I've been saying. But, you know, I didn't see anything in the letters about what the League would do to stop the incoming tide. The demand for more and more satellite and other UHF channels is going to continue to grow exponentially, and we have the League saying they need more money. To do what, guys? What are you going to do, send baskets of money to Washington to be doled out (no pun intended) to Congress? You can't possibly match the commercial lobby money, so what will you do if we send you a big check? Party some more?

Yes, I have some good ideas on what could be done to help stem our loss of satellite bands. But first I want to know if (a) a significant number of our active hams really give a damn; and (b) what the Tech/Novice hams (now over half of us) think. Do many of them really care? In other words, if the League actually came up with a workable plan, but needed the support of the membership, would they get it? However, as far as I can see, other than begging for money, they have no plan of action.

Why should a 75m op care one whit about what happens to our 3300 MHz band? Or even 1300 MHz, for that matter? I suppose that the 20m DXers, contesters, certificate hunters, rag-chewers, the CW-forever crew, and so on couldn't care less what happens to our unused (and presumably unneeded) bands.

Until nearly 1970 the top half of 2m was a virtual desert. Heck, when *CQ* magazine proposed taking it away and making a new CB out of it there was almost no fuss. Then along came repeaters. Now we're willing to fight to hold onto our precious repeater band. But hey, why bother about our 500 MHz-wide band up at 10 GHz? Or a couple of unused 5 MHz segments of the 2300 MHz band? People in general, and hams in particular, don't think much about the future. If they did they wouldn't smoke or be grossly fat. These are denials of the future consequences of our actions.

So, guys, if we send you money, what will you really do with it? Will it be like sending money to Washington? Will it just go in the pot and be that much more to spend on current enthusiasms?

The Michigan Miracle

Maybe you can remember not long ago when Michigan had one of the highest unemployment rates in the country. When the state was a national disaster, verging on bankruptcy. While I'm not a fan of all the Republican party planks, the

Continued on page 22

QRX . . .

FCC Stops Renewal Reminders

As of October 22, the FCC has ceased issuing Form 610R license expiration notices—reminders to hams that their tickets are going to expire within the next 90 days and that they must request renewal. The last notices sent by FCC covered into February 1997, although the specific date was not available. A Form 610R for renewal must be returned by mail only to the FCC.

The demise of the Form 610R means that hams—whose licenses are issued for 10-year periods—must take the initiative to remember the renewal date of their tickets and file a Form 610. AN FCC spokesman in Gettysburg says the Commission hopes to have a Form 610 available soon on the World Wide Web to permit on-line renewals.

From *The Repeater*, official newsletter of the Alamo Area Radio Organization, San Antonio TX.

Have You Applied for a Vanity Callsign?

The FCC will not start making any grants for first-day filers until all day-one applications have been entered into the FCC's computer. Then applications will be processed randomly from among those in the first-day pool.

The number of hams taking advantage of Gate 2 has been less than anticipated. As of September 25, 1996, the FCC had received 5,297 Gate 2 applications. First-day vanity filers totaled 4,527, a number that even surprised the FCC, which had been expecting a larger flood of Gate 2 filings. The FCC said 4,188 paper applications and 339 electronic applications were received the first day. Another 770 applications, mostly paper, had showed up by Wednesday, September 25. Slightly more than 7% of the applicants used the FCC's newly inaugurated electronic filing system.

Among the major headaches for the folks in Gettysburg are applications that contain illegible information. FCC personnel have been instructed to skip over requested callsigns they cannot decipher. Also, some electronic filers have been sending their payments to the wrong Post Office box in Pittsburgh and using the FCC Form 159 designed for use by those filing on paper. The FCC said that contrary to instructions on the electronic application form, electronic filers should not forward a copy of their license to the FCC by mail. FCC personnel have no way to match up licenses with applications, and they don't need the license copy to process the application.

The FCC said that some applicants apparently have had second thoughts about changing their callsigns and have contacted the FCC to pull their Gate 2 paperwork. The FCC says that cannot be done. Those issued a vanity callsign who decide they like their old callsign better will have to pay another $30 and reapply under Gate 1.

If the FCC is unable to grant any of your vanity callsign requests, your application will be dismissed, and the FCC will notify you to that effect. But the Commission will not return your $30 until you request a refund in writing.

Excerpted from *Harmonics*, October 1996, official newsletter of the South Jersey Radio Association.

Alaskan Hams Sizzle During Forest Fires

It's a sign of how times have changed that ham radio was not even considered as a communications link by Emergency Management, because of the wide use of cellular phones, during the recent disastrous forest fires in the Big Lake area of Alaska. The Amateur Radio Emergency Service Net wasn't part of the scenario. Hams were used for some of the communications during the Miller's Reach fire, but only after going to the Emergency Management people to make their availability known.

Communications ground to a halt when telephone lines and cellular phone frequencies were so overloaded they jammed. So many people were trying to get in touch with loved ones in fire-threatened Southcentral Alaska that the local cellular companies had radio stations begging people not to use their cellular phones; landlines were taking a minute or more just to come up with a dial tone.

Hams to the rescue! "My XYL, who is not a ham, and rarely pays attention to what I am listening to or doing on the radio, was totally impressed with the number of hams who suddenly came from nowhere to be just about everywhere," wrote Bob NL7QP, editor of *Mara News*. "We must continually make our communities aware of the importance of amateur radio during a disaster. We need to make better use of the bands we have, and encourage that use so we can retain those bands."

Condensed from an editorial in *Mara News*, the official newsletter of the Matanuska Amateur Radio Association, Wasilla, AK.

The Boy and the Frog

A boy was crossing a road one day when a frog called out to him, "Kiss me and I'll turn into a beautiful princess."

The boy picked up the frog and put it in his pocket.

The frog said, "If you kiss me, I'll turn into a beautiful princess, and I'll stay with you for a week."

The boy took out the frog, smiled at it, and returned it to the pocket.

The frog cried, "If you kiss me and turn me back into a princess, I'll stay with you forever, and do anything you want!"

Again, the boy took out the frog, smiled at it, and put it back. After a long pause, the frog asked, "What is it? Why won't you kiss me?"

The boy answered, "Look, I'm an amateur radio operator. I don't have time for girlfriends, but a talking frog—hey, that's cool!"

Lifted from *ARNS Bulletin,* October 1996.

Learn More About QRP

Founded in January 1994, CQC brings amateurs interested in low power together, and endeavors to expand their interests and give them a forum in which to discuss problems and accomplishments. Besides its bimonthly meeting for local members, CQC publishes a bimonthly newsletter, *The Low Down. The Low Down* contains technical articles, product reviews, member news, upcoming activities, and an activities calendar. CQC membership is open to anyone interested in QRP.

In eastern Colorado try the Colorado QRP Club net every Monday evening at 8 PM on the 147.225 repeater in Golden, and on the 145.160 machine in Colorado Springs. They also use 146.445 simplex. On HF, call "CQ CQC" at 8 PM on 3710 kHz (the national 80 meter QRP frequency).

For an application form, send an SASE to Mark Meyer, 14153 West First Drive, Golden CO 80401. Membership dues are $10 a year, including a subscription to *The Low Down.*

Excerpted from *ARNS Bulletin.* October 1996. 73

The ScopeMixer

An adventure in ham radio systems integration.

Dave Evison N6GKC
153 Park Avenue
Palo Alto CA 94306

How would you like to adjust your antenna tuner while your rig is terminated in a dummy load? (Your final amplifier and fellow hams sure would!) Or how about monitoring your SSB signal and checking the peak envelope voltage for clipping and crossover distortion? (Wow, talk about good operating practice!) And wouldn't it be great to check the rise and decay time of your CW envelope and be able to *see* those chirps or clicks? Or how about being able to detect and measure harmonic radiation and other spurious products (just like the big guys)? Well, even if you're sitting on a very thin billfold, you can manage all of this—and more—with a ScopeMixer System. While it's primitive by commercial standards, it can provide you with a versatile measurement system at very low cost. The ScopeMixer will empower you (without spectrum analyzers and other professional laboratory instruments) to produce superior, well-tested designs.

The ScopeMixer System is an example of ham radio systems integration: a couple of simple circuits containing only one active component (a 10-cent transistor), an inexpensive 40-year-old kit oscilloscope ($15 at any ham flea market), a secondhand MFJ SWR Analyzer used as a local oscillator (about $40—but you may already have one of these handy little devices). Now that's real ham engineering!

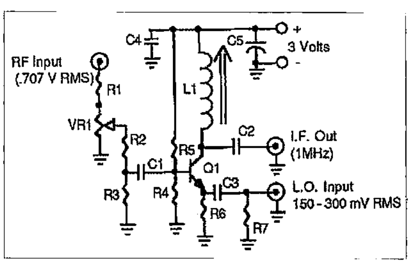


Fig. 1. ScopeMixer schematic.

The ScopeMixer is a good example of recycling older technology that is rarely used today: the wave analyzer. The wave analyzer has been supplanted by the spectrum analyzer in most commercial laboratories, but it's still simple, inexpensive, and provides an impressive measurement capability.

The design criteria for the ScopeMixer were to keep the cost and parts count low and use only readily available parts. The result is a straightforward bipolar mixer using a 2N2222A transistor (**Fig. 1**). The RF is applied to the base, the local oscillator to the emitter, and the IF taken from the collector—it really couldn't be simpler—and with 2N2222 transistors selling for less than 10 cents, it couldn't be much cheaper. There is no IF transformer. Instead, an old broadcast "ferrite loopstick" is used. The unit draws less than 10 mA and requires only a 3 volt supply (a couple of AA batteries in series).

How it works

The ScopeMixer is a simple application of a heterodyne mixer. It converts the RF input to a 1 MHz intermediate frequency, which is well within the bandpass of the ancient oscilloscopes. While any frequency between about 550 kHz and 1600 kHz can be used for the IF, 1 MHz simplifies setting the local oscillator when measuring harmonic and other spurious products.

The ScopeMixer was designed to use an MFJ (or Autek) SWR Analyzer as a local oscillator working either 1 MHz above or below the RF. Harmonics and other spurious emissions are measured by establishing an IF reference level at the carrier frequency, then tuning the local oscillator up or down from the carrier frequency and observing signals that develop an IF of 1 MHz. For example, if a reference carrier of 7 MHz having a second harmonic component is connected to the ScopeMixer, it will produce an IF of 1 MHz at 6 MHz and 8 MHz (reference frequency) and at 13 MHz and 15 MHz (the second harmonic). The amplitude of the harmonic responses when compared to the amplitude of the reference carrier will determine their relationship in decibels (dB).

To understand the input circuit refer to **Fig. 1**. The values of R1 through R4 were calculated to deliver 25 millivolts rms to the base of the 2N2222 when 707 millivolts (.707 volt) rms is applied at the RF input. While the 2N2222 in this configuration will work with levels significantly greater than 25 mV at its base, it becomes quite nonlinear. Maintaining 22

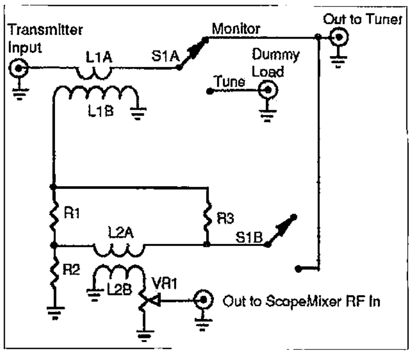


Fig. 2. ScopeMixer Range/SWR Unit.

to 28 mV at the base will enable the ScopeMixer to display levels as low as -30 dB (referenced to the input level).

The pot will allow fine-tuning to the desired 25 mV when levels slightly greater than 0.707 V rms are applied to the ScopeMixer RF Input. I recommend that the pot be kept full-on and that the input to the mixer be trimmed using the range control pot on the Range/SWR Unit.

The Range/SWR Unit samples the RF source to be monitored. It accommodates RF levels from 180 mW to over 100 W. It also includes an antenna bridge for performing "stealth" antenna tuner adjustments. In **Fig. 2,** you see that the RF signal to be monitored/measured is sampled inductively by L1A/L1B. With S1 in the tune position, the RF source is terminated in an external dummy load, and a small sample of the RF energy is used for antenna bridge excitation. R1, R2, R3, and the antenna system are configured as a simple antenna bridge—and the ScopeMixer is used as the detector. Using the oscilloscope readout of the ScopeMixer provides great sensitivity, smoothness and resolution. L2A/L2B transfer the signal developed by the unbalanced condition of the bridge to VR1 which provides level control to the ScopeMixer. VR1 functions as the RF range control. With S1 in the monitor position, the unbalanced bridge signal is fed to the ScopeMixer through L2A/B and VR1. This signal is used as both the calibration level for SWR measurements and reference level for attenuation measurements.

ScopeMixer construction

I'm a great fan of Wes Hayward and his Ugly Construction, and my ScopeMixer is an excellent candidate. If you're not familiar with ugly construction, check the *ARRL Handbook* (it's actually listed in the index of some issues under "Ugly"). The accompanying photo shows a prototype ScopeMixer mounted in a small metal box (note that ugly construction was retained).

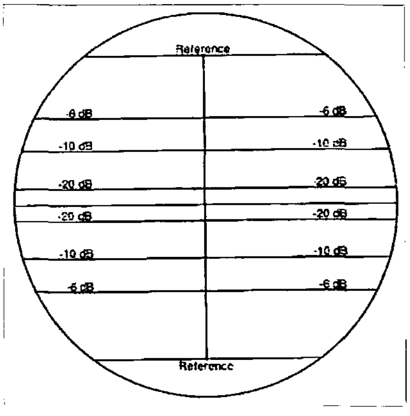


Fig. 3. Calibration overlay grid.

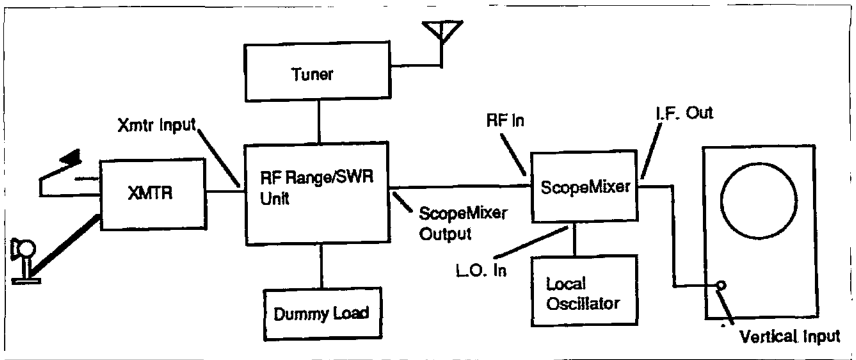


Fig. 4. ScopeMixer Range/SWR Unit system setup.

Range/SWR Unit construction

L1 and L2 are RF transformers made by winding secondaries over off-the-shelf Radio Shack™ 100 µH RF chokes (RS #273-102). Before winding the secondary onto L2 (30 turns #26 enameled), it's a good idea to put a layer of masking tape over the windings of the choke. The primary (L1A) is four turns of stranded, insulated wire (about #20).

The Range/SWR Unit should be enclosed in a suitable chassis box for both shielding and prevention of RF burns. Use a good quality wafer-type switch (do not use a toggle-type switch) and ensure the switch is a break-before-make type.

Making a calibration overlay grid

A pattern for a calibration overlay grid is shown in **Fig. 3.** Using this overlay grid will simplify measurements and increase accuracy.

Make an overlay from the magazine pattern by copying the image onto an overhead transparency sheet. Then cut the overlay out and place it on the face of the cathode ray tube. Align the center horizontal line of the overlay grid with the oscilloscope trace.

Measurements

The ScopeMixer will allow you to make attenuation measurements in decibels (dB). Since dB measurements are relative measurements (compared to an identified reference level) you will be able to rely upon the basic accuracy of the oscilloscope's vertical deflection linearity—which in the case of the older kit scopes works out to be about 5%. Overall accuracy is cumulative and factors such as local oscillator leveling, gain-bandwidth product of the 2N2222, noise, etc., all contribute. But, after all, the ScopeMixer is for ham applications, not rocket science.

To minimize identified noise and gain problems, measurements should be performed on the X1 range and utilize the large CRT deflection (4 to 5 inches). In this manner, deflection accuracy will be limited to the vertical deflection linearity and the gain control will be closer to halfway on.

Using the scope attenuator to provide 20 dB gain (for example, establishing a reference level on X10, then setting the scope to X1 for measuring attenuation—equivalent to 20 dB gain) is not recommended because noise components increase dramatically as the variable gain control is set at or near maximum. A second reason for not using the scope attenuator in the measurement scheme is that above 1 MHz the scope's internal attenuator compensation adjustments greatly influence the actual gain/attenuation between steps, and among the three kit scopes used for this project, all three had severely maladjusted attenuator compensation.

Oscilloscopes with wider bandpass characteristics *do not* work well with the ScopeMixer system as they are sensitive to unwanted signals appearing in the IF output (local oscillator, RF fundamental, etc.). If a wideband scope is used, an IF transformer with a tuned primary and secondary will be required. The low cost of the older oscilloscopes, and their performance

in this application, justify their dedication to the system.

For amateur applications, measurements are generally made while performing adjustments for peaking or nulling. For example, you've just finished a QRP rig and you want to check for, and if necessary attenuate, harmonics and other spurious products. In this case your concern is not the accuracy of the harmonic level, but rather to be able to detect it and reduce it as much as possible. In this case the ScopeMixer will be able to display the spurious signal. You peak the display using the local oscillator, and then make adjustments to the rig, or substitute new components in the circuit, to reduce the level of the spurious signal.

There is nothing particularly critical about setting up the system. Use high quality RG 58U coax cable and BNC connectors, and ensure that excessive RF is not applied to the Range/SWR Unit. The power level should not exceed 100 watts. Interconnect the equip ment as shown in **Fig. 4**, and set the equipment as specified under "Equipment Setup."

In adjusting the loopstick, start with the slug in about halfway. Apply the local oscillator frequency (approximately 1 MHz above or below the RF input signal); set the pot on the ScopeMixer fully clockwise and adjust the Range/SWR Unit pot to the level of RF to be applied.

Key the transmitter and apply a CW signal to the system. Fine-tune the local oscillator to produce maximum vertical deflection and stabilize the display. Adjust the focus control for best trace. Then adjust the variable gain and vertical position controls to set the waveform peaks to the reference levels **(Fig. 6)**.

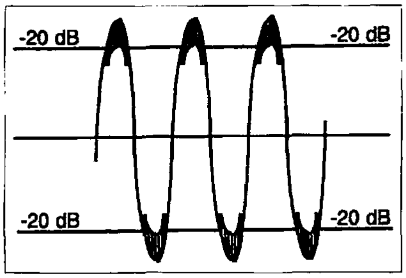


Fig. 5. Although the peak-to-peak amplitude of this waveform measures greater than -20 dB, "subtracting the fuzz" results in a more accurate measurement of -20 dB.

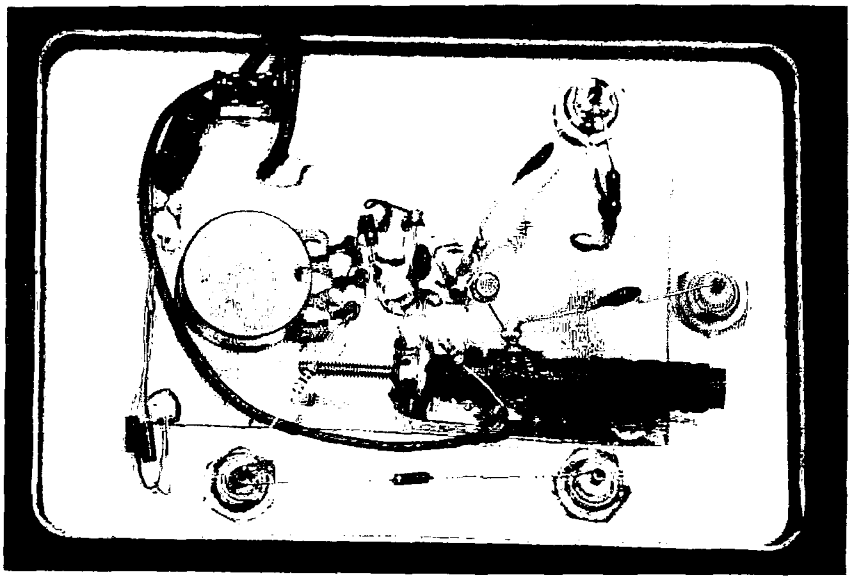


Photo A. *A peek inside the ScopeMixer.*

Note the frequency of the local oscillator and compare it to the frequency of the applied RF. If the frequencies are separated by more than 1 MHz, adjust the slug further into the coil: if separated by less than 1 MHz, adjust the slug out of the coil. Repeat this process until a 1 MHz ±10% IF is achieved.

To check the SWR function of the Range Unit and adjust the tuner for minimum SWR, interconnect the equipment as shown in **Fig. 4**. Set the Range/SWR Unit to the tune position, then remove the antenna tuner from the Range/SWR Unit. Key the transmitter and apply a CW signal. Fine-tune the local oscillator, and peak and synchronize the IF display. Set the waveform peaks at the reference levels (**Fig. 6**). Remove RF power.

Connect a 50Ω non-inductive resistor to the tuner port, then key the transmitter. The peak-to-peak display should be approximately 1/4 inch or less (**Fig. 8**).

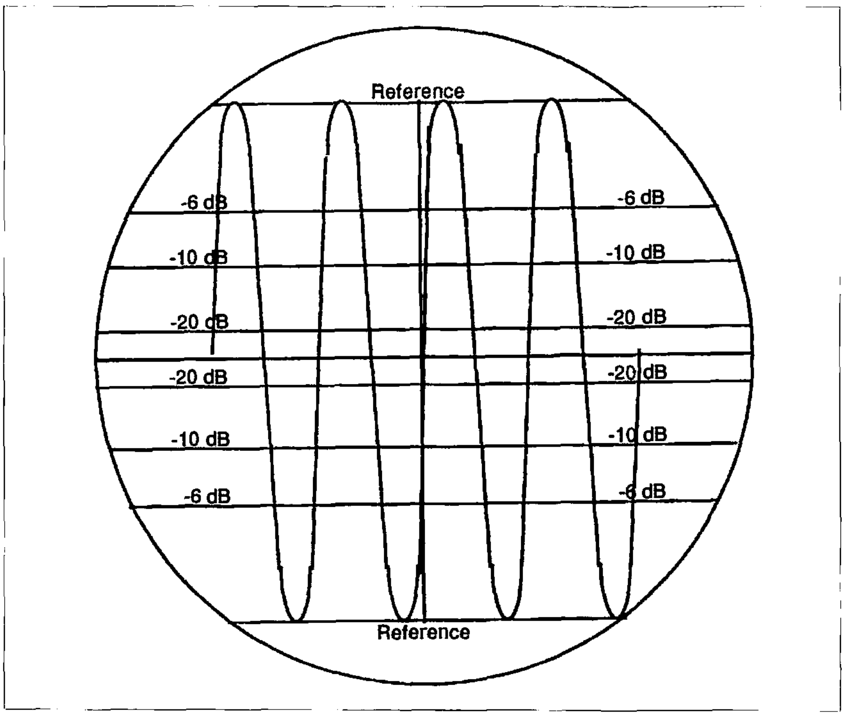


Fig. 6. *Reference level.*

Remember to subtract the fuzz. Remove RF power from the system. Remove the 50Ω resistor and reconnect the tuner and antenna system. Key the transmitter and adjust the tuner for minimum deflection.

Equipment setup

Oscilloscope front panel control settings:
- Vertical attenuator: X1
- Variable gain: 40
- Horizontal sweep: 100 kHz
- Horizontal vernier: 80
- Horizontal gain: 20
- Sync selector: Int +
- Intensity and focus for best trace.

Local oscillator (LO) (MFJ or Autek SWR Analyzer) settings:
- Frequency: 1 MHz below the RF source to be measured.

ScopeMixer settings:
- RF input pot fully clockwise, power switch on.

RF range/SWR unit settings:
- Set tune-monitor switch to monitor
- Set range pot according to the amount of power to be sampled. If possible limit the RF level for initial settings from 5 to 10 watts.

Measuring harmonics and other spurious products

First, establish a reference level at the fundamental carrier frequency being measured. Once set, the vertical gain control should not be readjusted until all measurements have been made and noted. The local oscillator is then adjusted above and below the carrier while watching the scope for intermediate frequency responses. Harmonics, of course, will be multiples of the carrier frequency, but other spurious responses will not. Once a response is detected, peak the signal using the local oscillator, and read its amplitude (in dB) from the calibration grid. The frequency of the spurious signal is determined by adding or subtracting 1 MHz (depending upon whether the local oscillator is operating above or below the spurious response).

Note: Below -20 dB, noise and the width of the trace significantly limit accuracy. With experience, you can improve such measurements by "subtracting the fuzz" from the measurement (**Fig. 5**).

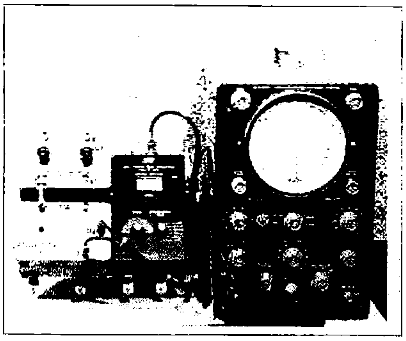


Photo B. ScopeMixer system with scope...

Monitoring modulation

Monitoring modulation is limited to observing the modulation envelope, but a great deal of information can be gathered in this manner—single sideband peak envelope voltage clipping and crossover distortion can be observed. Refer to the *ARRL Handbook* for more information on these parameters.

Examining keyed carrier waveforms

With the transmitter in the CW mode, key the transmitter by sending a series of evenly spaced dits and adjust the horizontal vernier to observe the keyed envelope.

Measuring SWR

Remove the antenna tuner from the Range/SWR Unit, then set the RF Range/SWR Unit to the tune position. With the transmitter in the CW mode, key the transmitter and fine-tune the local oscillator to peak the oscilloscope display. If the rig is SSB-only, set it to tune. Adjust the Range pot until the peak-to-peak signal is set to the reference levels on the calibration overlay grid. The oscilloscope vertical position control may

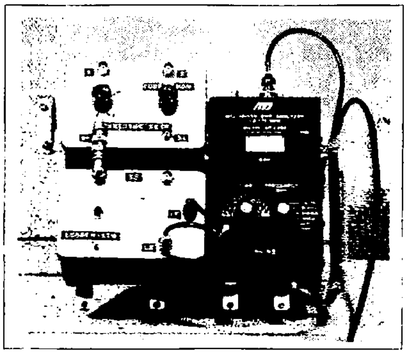


Photo C. ... and without the scope.

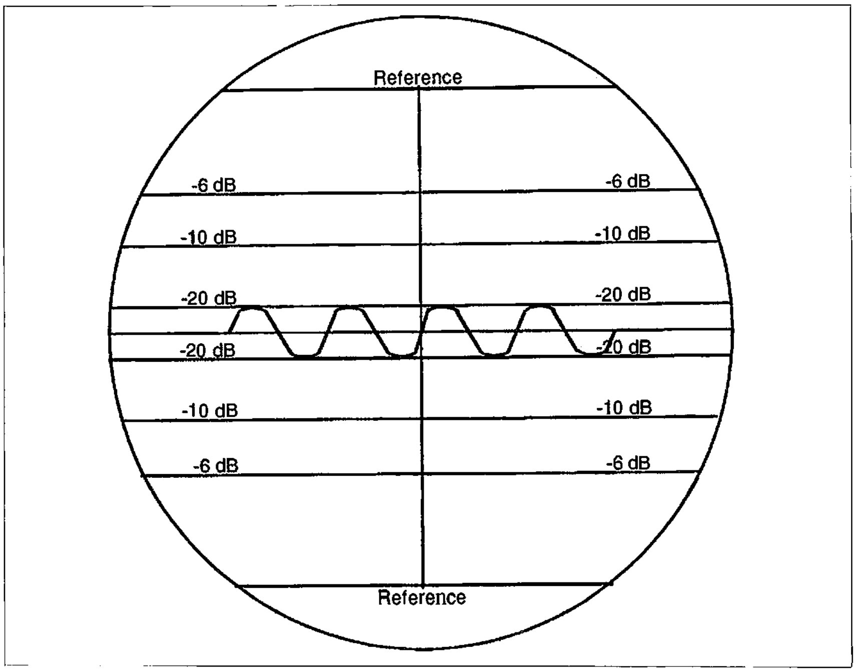


Fig. 7. -20 dB.

also require adjustment to position the waveform on the calibration grid (**Fig. 6**). Once set, remove RF power and connect a 50Ω non-inductive resistor to the tuner port. Key the transmitter. The peak-to-peak display should be approximately 1/4 inch or less (**Fig. 8**). Keep in mind that you need to subtract the fuzz (**Fig. 5**). Remove RF power from the system. Remove the 50Ω resistor and reconnect the tuner and antenna system. Key transmitter and adjust antenna tuner for minimum peak-to-peak display on the oscilloscope. A matched condition will result in a peak-to-peak display of approximately 1/4 inch (Fig. **8**). 73

ScopeMixer Parts List	
R1	75 Ω
R2	910 Ω
R3, R7	51 Ω
R4, R6	1 k
R5	4.7 k
VR1	200 Ω Linear Composition
C1, C2, C3	.001 µF
C4	0.1 µF
C5	10 µF
L1	Broadcast Ferrite Loopstick*
*Antique Electronic Supply Cat. #PC-70-A (or equivalent)	

Range/SWR Unit Parts List	
R1, R2, R3	51 Ω 1/2 W
VR1	600 Ω Linear Composition
S1	DPDT Wafer Switch (break-before-make)
L1B, L2A	100 µF RFC (Radio Shack 273-102)
L1A	4 turns #22 insulated wound over L1B
L2B	30 turns #26 enamel covered wound over L2A (cover L2A with a layer of masking tape before winding L2B)

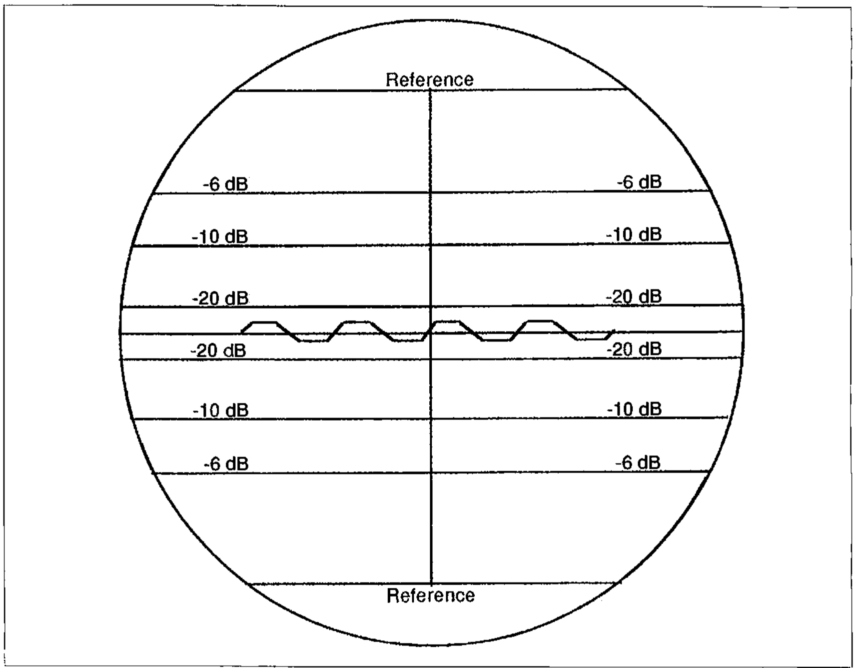


Fig. 8. SWR null.

Number 17 on your Feedback card

A Flexible Keyer

A weekend of investment; a lifetime of ease.

Parker R. Cope W2GOM/7
8040 E. Tranquil Blvd.
Prescott Valley AZ 86314

An inexpensive flexible keyer can be built with two 4000 series CMOS ICs to generate independently adjustable self-completing dots and dashes. The keyer can drive an inexpensive MOSFET cathode switch that will key anything from a solid-state QRP rig to a kilowatt tube final. The keyer includes an optional sidetone generator that can be used as a code practice oscillator while you learn to use the keyer.

The keyer described generates a keying waveform whose weight can be adjusted to suit your preference. This weekend project uses no critical parts or unique ICs, so, depending on the state of your junk box, construction costs can be low. Equations are given to allow modification of the design to fit the parts you have.

The keyer generates a keying waveform that drives a MOSFET transistor to cathode-key a tube type transmitter or switch a positive voltage to ground to key a solid-state exciter. Some solid-state transmitters switch a positive voltage in the exciter to ground for keying and refer to it as "cathode keying." That is likely a misnomer because the only cathodes are probably cathodes of semiconductor diodes. Just so we can all sing from the same hymnal, I will refer to switching a positive voltage to ground as "cathode keying."

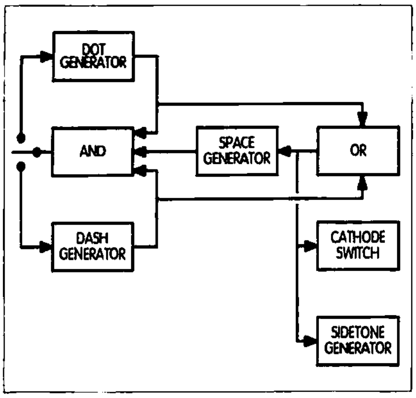


Fig. 1. The keyer is built around monostable multivibrators and combinatorial logic.

The keying speed is variable from less than five to about 30 words per minute with a single front panel control. Equations are given for selecting parts to allow higher keying speeds. The weight is adjusted internally and is maintained for all speeds. A front panel toggle switch is provided to produce continuous "key-down" for transmitter tuning. The optional sidetone generator can provide about 100 mW of audio to drive low impedance phones or a speaker. This power is adequate for most situations.

The functional block diagram in **Fig. 1** shows how three monostable multivi-brator pulse generators and logic elements can be used to produce the keying waveforms. One multivibrator generates the dash period, the second generates the space period, and the third generates the dot period. The space-to-dash ratio and dot-to-dash ratio of the keyer are adjusted independently. The selected ratio of dot/dash/space is maintained for keying speeds from 5 WPM to 30 WPM. The monostable

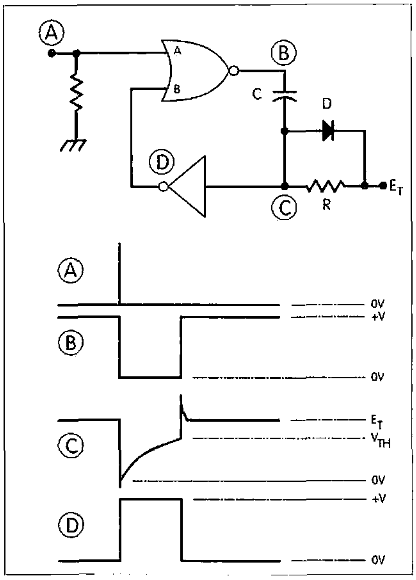


Fig. 2. A monostable multivibrator built with CMOS has these critical waveforms.

multivibrators used are non-retriggerable. Once a pulse is initiated, subsequent triggers during the period of the pulse have no effect on the pulse duration.

A typical monostable multivibrator is shown in **Fig. 2**. The timed period is determined by R x C, V_{TH} (a characteristic of the IC), and E_T, the timing voltage controlled by the "Speed Control." The threshold, V_{TH}, of 4000 series CMOS is between $0.45V_{DD}$ and $0.55V_{DD}$. V_{DD} is the supply voltage +V. While the match of thresholds from one chip to another may vary 20%, the match of units within an IC is very close. Therefore, the inverters are all within one IC to ensure tracking of the periods as E_T is varied. Each of the multivibrators uses one section of the CD4009 hex inverter. The ICs can be either AE or BE versions; use whatever is available.

In a NOR gate, the output is "low" (zero volts) when either input "A" or "B" is more positive than V_{TH}, and is "high" (+V) when both inputs are more negative than V_{TH}. In **Fig. 2**, the resistor at the "A" input of the NOR gate holds that input "low" until a positive trigger drives it above V_{TH}. The "B" input which is connected to the output of the inverter is "low" because the positive voltage, E_T, at the inverter's input is above V_{TH}. When a positive pulse is applied to the "A" input of the NOR, the output goes "low." This negative transition is coupled through C to the input of the inverter and drives the inverter's input below V_{TH}. The inverter's output goes "high" and holds the "B" input of the NOR gate high until C, charging through R toward E_T, reaches V_{TH}. While the inverter's output is "high," the "B" input to the NOR gate holds the output low and triggers to the "A" input have no effect. The stable state of the multivibrator is both inputs of the NOR gate "low" and the input of the inverter held "high." The unstable state, or timing state, has the output of the NOR gate low, C charging toward E_T, and the inverter output high.

The transition of the NOR's output from +V to zero will try to drive the input of the inverter negative (below ground) when E_T is less than +V. The IC's input protection circuit limits the negative voltage to one diode drop below ground. On the positive transition of the NOR's output, the positive swing on the inverter's input is clamped to E_T by the diode across R.

The voltage on the input of the inverter rises toward E_T at a rate controlled by R and C. The instantaneous voltage on the gate is:

$$V_c = E_T \times (1 - e^{-t/RC})$$

This can be rewritten in terms of t and RC:

$$-t/RC = Ln(1-V_c/E_T)$$
$$t = -RC \times Ln(1-V_c/E_T)$$

where t = time in seconds
R = ohms
C = farads
Ln = the natural logarithm
V_c = the instantaneous voltage across the capacitor
E_T = the speed control voltage

When the gate voltage V_c reaches V_{TH}, the output of the inverter switches. Since each pulse generator's period ends when $V_c = V_{TH} = 0.5V_{DD}$, the time of the pulse can be written as:

$$t = -RC \times Ln(1-V_{TH}/E_E T) = -RC \times Ln(1-0.5V_{DD}/E_T)$$
$$t = RC \times 0.69 \text{ when } E_T \text{ equals } V_{DD}$$

When all three pulse generators have the same V_{TH} and E_T, the pulse generators maintain their ratios as E_T is varied. The minimum pulse period (highest keying speed) occurs when E_T is +V and the slowest speed occurs when E_T is near V_{TH}.

The duration of the unit timing period, which is equal to the time of a dot or space, is determined as follows: The standard word "PARIS," requires 48 unit periods (dot periods). Therefore, at 30 words per minute (half a word per second) there are 24 unit periods per second and the duration of a unit period is about 0.042 seconds. To produce a dot period of 0.042 seconds requires an RC of 0.029 seconds (0.042 x 0.69). A standard 3:1 dash period is 0.126 seconds and the RC is 0.087 seconds. The dot and space are varied with respect to the dash to change the keying weight. The value of E_T/+V for various keying speeds is given in **Table 1**.

The keyer shown in **Fig. 3a** uses two CMOS ICs: a CD4001 quad NOR gate and a CD4009 hex inverter. U1A and U2A generate the dot pulse, U1B and U2B generate the dash pulse, and U1C and U2C generate the space pulse. The dot period is determined by C2 x (R2 + R3) and E_T; the dash period is determined by C3 x R5 and E_T; the space period is determined by C6 x (R9 + R10) and E_T. The dot pulse or dash pulse is triggered with the positive voltage switched through the key. The voltage on the arm of the key is obtained from the AND formed by D5 and D6. The keying waveform for the gate of Q1 is obtained by ORing the dot and dash pulses. The trigger for the space generator is obtained by differentiating the keying waveform with C5 and R8, and inverting the negative transition with U2E. The keying waveform is inverted by U2D to gate the sidetone generator

Timing Voltage vs. Keying Speed

E_T/ +V	Unit period secs.	Speed
1.000	.042	30
.884	.050	25
.769	.063	20
.667	.083	15
.571	.125	10
.507	.250	5

Table 1.

and AND'd with an output from the space pulse generator with D5 and D6 to produce the voltage for the arm of the key; the diodes D5 and D6 clamp the arm of the key low during the key-down and space period. The arm of the key returns to +V only after the end of the dot/dash and space periods. Therefore, only after the dot/dash/space period ends is there a positive voltage available at the key to provide a trigger or re-trigger for either the dot or dash with a key closure. R7 provides the pull-up for the diode AND and in conjunction with C1 and C4, filters out the spike that can occur during the transition from key-down to the space period. The capacitors C1 and C4 also filter any RF that may be picked up on the leads from the key.

The sidetone oscillator, shown in **Fig. 3b** as U1D and U2F, is an astable multivibrator that oscillates at a frequency determined by R14 and C8. The oscillator is gated "on" when the output of U2D applied to U1D (via point A) is zero. The values of C8 and R14 shown in **Fig. 3b** generate a 720Hz square wave during "key-down." To lower the frequency increase R14 or C8. The output current capability of U2F is in the range of 2 mA which is fine for driving CMOS gates or other high impedance loads, but is inadequate for low impedance loads like phones or a speaker. A simple MPF930 source-follower easily provides 100mW of audio power to an 8 ohm speaker or phones.

For example, the typical MPF930 has a threshold of about 3V gate to source and saturates at 0.2A with a gate to source voltage of about 4V. R15 controls the input voltage to Q2. When the input is 3V or less the source voltage is zero and when the drain current is 0.222A the gate to source required is about 4.2V. With 0.222A flowing in 8 ohms, the voltage across the speaker is about 1.8V. Therefore the peak voltage at the gate must be 1.8 + 4.2 or 6 volts. To obtain 100mW of audio into an 8 ohm speaker or phones requires a power supply of at least 6V. A different speaker resistance or power output would require a different supply voltage. The current drawn from the supply is in the range of 0.25A which warrants an AC powered supply. When the supply voltage is more than 6V, a resistor R16 in series with the speaker will limit the maximum current under full volume. With an 8V supply,

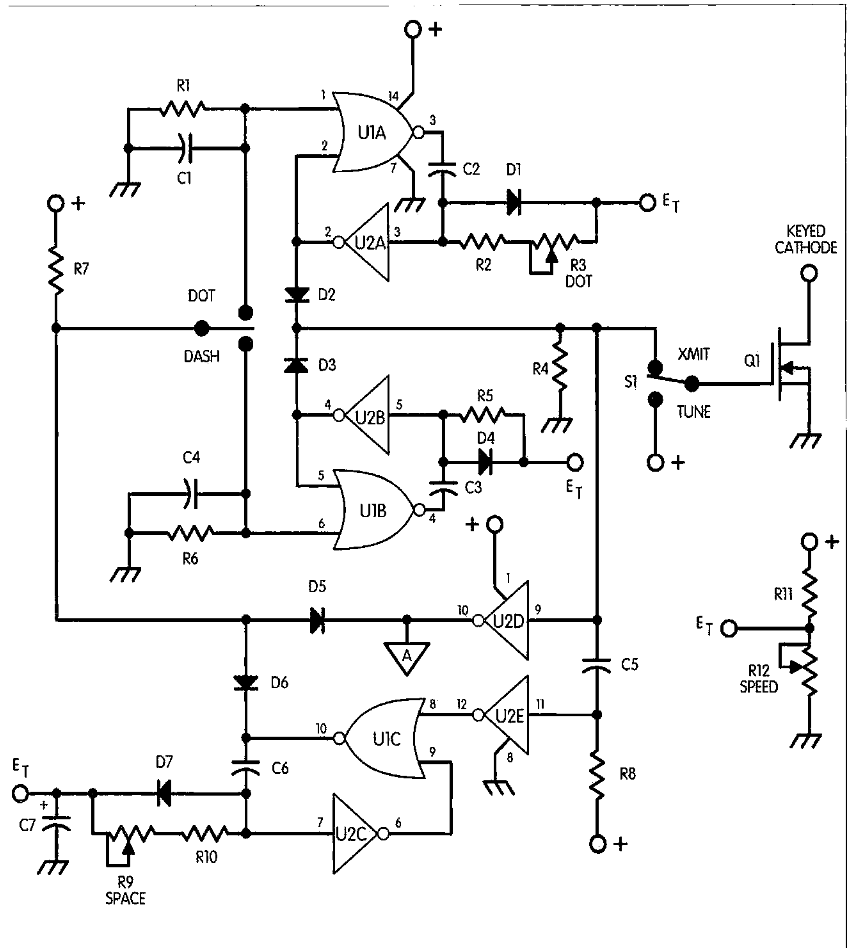


Fig. 3a. The keyer uses garden-variety CMOS ICs.

R16 should be 13 ohms but with a 12V supply, it should be 27 ohms. If the sidetone generator is not desired, delete the parts marked * in **Table 2** and tie the inputs of U1D and U2F to either +V or ground.

The electrical parts list for **Fig. 3a** and **Fig. 3b** is given in **Table 2**. Most of the parts are available from Radio Shack™, and those that are not in the retail catalog will be ordered by most Radio Shack stores from Radio Shack Unlimited. If your cupboard is bare and your local store won't order from Radio Shack Unlimited (RSU), equivalent parts can be obtained from almost any industrial electronics distributor. For example, Digi-Key, PO Box 677, Thief River Falls, MN 56701-0677; toll-free order number is (800) 344-4539.

Keying a solid-state transmitter involves switching a relatively low voltage so the "cathode" switching transistor can be safely located in the keyer. Switching 48 volts or less can be done safely with Q1 in the keyer, but if a vacuum tube final is to be keyed, prudence and safety dictate that Q1 should be located near the cathode of the keyed stage to keep the high voltage out of the keyer and away from the operator.

The choice of Q1 depends on the requirements of the transmitter to be keyed. The MPF930 is a TO-92 N-channel enhancement mode MOSFET that can switch +30 volts. While the drain current is rated as 2A, this specification is not very meaningful because thermal conditions limit the current carrying capacity to something in the range of 0.5A in a 122°F ambient temperature. The MPF960 can switch +60 volts. Either the MPF930 or the 960 will be sufficient to key most solid-state exciters. The drain saturation resistance is about 10 ohms which results in a drain to source voltage of about 0.5V when drain current is 0.5A, and about 0.25V when drain current is 0.25A.

Keying a vacuum tube power amplifier requires the keying transistor to switch voltages sufficient to cut off the tube and be capable of carrying the peak cathode current. A typical kilowatt tube final will be cut-off with +100 volts or so applied to the cathode and cathode peak current will be less than 1A. **Fig. 4** shows how the MOSFET can be used to cathode key a high power amplifier stage. $E_{c/o}$ in **Fig. 4** is a positive voltage sufficient to cut-off the keyed tube for "key-up" conditions, that is, when Q1 is not conducting. Of course, $E_{c/o}$ can be obtained with a resistive divider if need be. The value of the resistor between the cathode and $E_{c/o}$, or Thevenin's equivalent source resistance of the divider, is arbitrary; it must supply the cut-off voltage at zero current during "key-up" and limit the current from $E_{c/o}$ during "key-down."

An N-channel power MOSFET for Q1 is an ideal switch in that drive power is practically nil even though the drive voltage must swing from ground to nearly +10V. The package style essentially determines the power that the device can dissipate without a

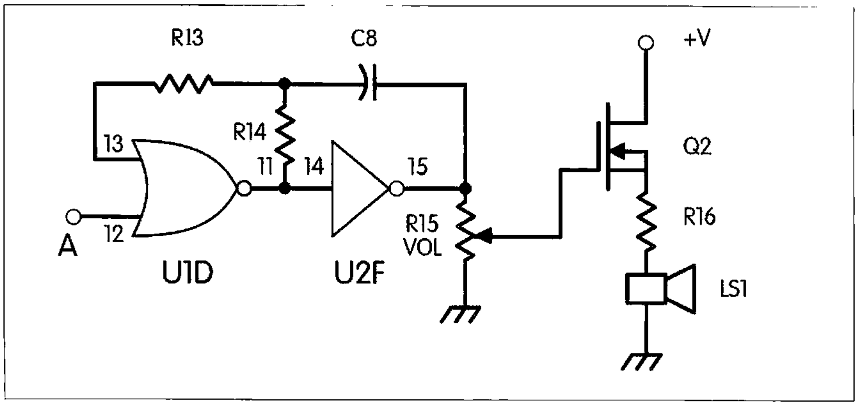


Fig. 3b. The sidetone generator is optional.

Electrical Parts List for Figs. 3a and 3b

Circuit Symbol	Description	Number
C1, 4, 5	100 pF ceramic	272-126
C2, 3, 6	0.1 ± 10% µF film	272-1069
C7	2.2 ± 20% µF electrolytic	272-1435
C8*	0.01 ± 10% µF	272-1065
C8	2.2 µF electrolytic	272-1435
D1, 2, 3, 4, 5, 6, 7	1N4148 switching diode	276-1122
LS1*	8Ω speaker: see text	276-2401
Q1	see text	
Q2	MPF930 N-channel MOSFET	RSU
R1, 2, 4, 6, 8, 10, 11, 13*, 14*	100k ± 5% 1/4W	271-1131
R3, 9	500k ± 5% 0.1W trimmer	RSU
R7	10k ± 5%	271-1335
R5	1.8M ± 5% 1/4W	RSU
R12, 15*	100k ± 20% panel mounted pot	271-092
R16*	see text	
S1	SPDT	275-603
U1	CD4001 AE or BE	276-2401
U2	CD4009/4049 AE or BE	RSU

* Used only with the optional sidetone generator of Fig. 3b

Table 2.

heat sink. For example, a TO-220 package has a junction to ambient thermal resistance R_{JA} of 62.5°C/W and the junction temperature must not be allowed to exceed 150°C. When the device dissipates 2 watts the junction temperature rises 125°C above ambient which limits the ambient to 25°C. The temperature near the tube socket of a tube final can approach 100°C. Under these conditions the power dissipation in the switch would have to be limited to 0.4 watts. A heat sink reduces the thermal resistance from case to ambient and since the device's junction to case thermal resistance, R_{JC}, is only few ohms (in the range of 2°C/W), a moderate heat sink can be effective in reducing the junction's temperature rise.

In general, the die size of a device determines the DC current rating and saturated drain resistance, R_{DS}, other conditions being equal. For example, Motorola's MTP2N20 has an R_{DS} of 1.8 ohms, while the MTP5N20 has an R_{DS} of 1 ohm, and the MTP8N20 has an R_{DS} of 0.4 ohm. For a given drain current, the saturated dissipation is directly related to R_{DS}. Therefore, a larger die has lower power dissipation for a given current. A MTP2N20 dissipates 1.8W when the drain current is 1A, the MTP5N20 dissipates 1W, and the MTP8N20 dissipates 0.4 Watts. The junction temperatures for the three devices would be 112.5°, 62.5°, and 25° respectively. Holding the junction temperatures to under 150° limits the operating ambients to 38°C, 87.5°C and 125°C respectively.

It goes without saying that MOSFETs with higher current ratings have larger dice and cost more than the lower current devices. A moderate heat sink similar to Radio Shack P/N 276-1363 with a thermal resistance of 30 ohms is a cost-effective solution to using lower current devices in higher ambients. For example, the MTP2N20 has R_{JC} of 2.5°C/W and with a 30 ohm heat sink the junction temperature rise, when switching 1A, is (30 + 2.5)°C/W x 1.8W = 58.5°C, which means it can operate in an ambient of 91.5°C. The MTP5N20 has R_{JC} of

1.67°C/W and under the same conditions the dissipation is 1W and junction temperature if (30 + 1.67)°C/W x 1W = 31.67°C. With a heat sink, it could operate in an ambient of 118°C.

However, if the cathode current were 2A, the power dissipated in the devices would be four times greater and the heat sink would be more important. Even with a 30 ohm heat sink the junction temperature of the MTP2N20 is an unacceptable 234°C. The MTP5N20's junction temperature would be 126.7°C. The lower R_{DS} of the MTP8N20 results in a dissipation of 1.6W. Its junction temperature rise is (30 + 1.67)°C/W x 1.6W = 50.7° and it can operate in an ambient of 99.3°C.

Clearly, the MTP8N20 is the transistor of choice if the cathode current to be switched is 2A while the MTP5N20 can be used to switch 0.9A in a 102°C ambient. A very thin coat of thermal grease between tab and heat sink is needed to achieve the lowest thermal resistance from case to heat sink. Low thermal resistance is desired because lower junction temperature leads to longer life.

A little less than 8V of gate drive is needed to drive either the MTP5N20 or MTP8N20 into drain saturation with 2A of drain current. Therefore, the keyer power supply should be greater than 8 volts.

The power supply for the keyer is not critical, except that the MOSFET Q1 dictates a minimum voltage of 8V or greater and the CMOS devices limit the maximum voltage to 18V. The current drawn by the keyer without the sidetone is less than 0.1mA and a 9 volt transistor battery has a life expectancy greater than 1000 hours. The current drawn by the sidetone generator is a function of the audio power output. With 100mW output into 8 ohms, the current is 111mA which is best obtained with an AC powered supply.

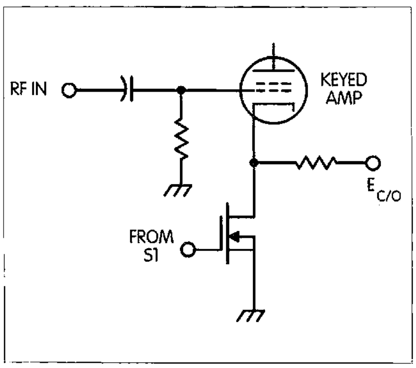


Fig. 4. A power MOSFET can cathode-key a high power RF amplifier.

Adjusting or tuning the transmitter can be done with a string of dots or dashes if the duty cycle is factored into the meter readings, 50% for dots and 75% for dashes. A "Tune" switch, S1 in **Fig. 3a**, allows the transmitter to be operated continuously for tuning and the transmitter's meters to be read directly.

Initial adjustment of the keyer to produce the standard timing—dot and space equal to one unit of time, and dash equal to three units of time—is straight forward. The only test equipment needed is an average-reading voltmeter, either analog or digital. Be aware that not all DVMs read average on the DC ranges. The procedure is as follows:

1. Connect an average-reading DC voltmeter between the drain of the switch transistor, Q1 , and ground.
2. Note the exact indicated voltage when the "Tune" switch, S1, is in the "XMIT" position, and the key is up. The voltmeter will read +V or $E_{c/o}$.
3. With S1 in "XMIT," close the key to the dash position and adjust the "space" trimmer, R9, to make the meter indicate exactly 25% of the voltage measured in Step 2. The meter's needle will flicker if the "Speed" control is set too slow. Set the "Speed" control to get a steady meter reading.
4. Close the key to the dot position and adjust the "dot" trimmer, R3, to make the meter indicate 50% of the voltage measured in Step 2.

That's all there is to it. The "space" trimmer controls the duration of the space relative to the dash period, and the "dot" trimmer controls the duration of the dot relative to the dash period. The dash period is controlled by the "Speed" control, R12 .

The sidetone generator is a separate option that may be used or not; it has no effect on the keyer. It doesn't monitor transmitter output; it only monitors when the key is down and the transmitter *should* be transmitting. If your transmitter doesn't have a built-in sidetone generator, this one can fill the gap.

The keyer is a fine weekend project for the flat-walleted brasspounder and the non-critical components suit the most limited junk box. With the design considerations given, you can modify the circuit to fit the parts at hand. The keyer can make generating the kind of CW you like easy, without spending a lot of money—and it may help clean a few pieces out of the junk box.

NEVER SAY DIE
Continued from page 7

Michigan Miracle is almost worth looking at. The Michigan unemployment rate was above the national average for 192 months in a row (1978-1993). It's been below the national average for the last 28 months and Michigan has been turned from a rust belt to a growth belt state.

The Republicans have eliminated the $1.8 billion debt; balanced the state budget for five years in a row; cut taxes 21 times!; downsized the state bureaucracy, while improving state services; and eliminated a bunch of red tape. For three years the state has led the nation in wage increases. Job creation has been at an all-time high. Michigan has proven that tax cuts not only work; they can work wonders! Now, if we could just get Clinton to try a tax cut. Instead he put through the largest tax hike in the history of the country.

They've reformed welfare, with the result that over 90,000 Michigan families are now on the payroll instead of the welfare roll. And one in three of the Aid to Families with Dependent Children (AFDC) is working as compared to one in 12 nationally.

Those Pesky ETs

There goes Wayne, off his rocker again. Well, some recent books I've read have certainly gotten me on a shuttle to Weirdsville. Unfortunately, since a good deal of it makes sense, I'm going to share it with you.

Unless you've been squatting in a cave somewhere, out of touch with the media, you know about Harvard professor John Mack, who decided to look into the stories of people claiming to have been contacted by aliens. His original intent was to show how this contactee stuff was all some sort of mass hysteria baloney. He ended up, after four years of research, publishing a book (*Abduction*) saying that the phenomenon is real, which immediately made him a pariah with his fellow professors.

If you've read Strieber's *Communion*, and his *Breakthrough*, both of which are tediously dragged out stories which can help you enhance your speed-reading skill, you know that tens of thousands of people have been reporting repeated contacts with ETs, and that most of them don't want to talk about it.

A reader sent me a copy of Dr. Arthur

Horn's *Humanity's Extraterrestrial Origins*, subtitled, "ET Influences on Humanity's Biological and Cultural Evolution." Yes, this sure sounds like another woowoo-weirdo book, based on wild speculation (imagination). Instead I found a very carefully researched and thoroughly referenced book. More about that coming.

Another similar book I read recently was also well researched and annotated. This was Temple's *The Sirius Mystery*. I've written about that recently. But, as carefully done as that was, I found Yin's *Pleidian Perspectives on Human Evolution* to be a waste of time. If you're interested in some solid pyramid research you'll want to get the $14 Bauval & Gilbert paperback, *The Orion Mystery*. And also, Tompkins' *The Secrets of the Great Pyramid,* which is $30 and a big (416p) book. The mystery of how these ancient civilizations suddenly sprung up is also discussed by Hancock in his *Fingerprints of the Gods*. All these books tie together in many ways, and lend support to the conclusions in Horn's book that aliens have been around for thousands to hundreds of thousands of years and have been guiding our biological and social development for their own purposes.

Horn points out that the introduction of many languages and religions has served to keep us at war with each other, thus keeping us busy and more easily controlled. Worse, he goes into details on how the major religions started, and then goes back to the most ancient of texts to support his theories.

Horn's theories also help explain why paleontologists have been unable to find any Darwinian predicted chain of evidence for the beginnings of man. Somehow, we magically appeared, with no signs of intermediate life forms having yet been found. Poof, suddenly there was man!

So, between Horn and his voluminous references, the Strieber books, the contactee stories, the millions of UFO reports, and so on, these theories do help tie together a bunch of evidence which mainstream scientists are doing their best to ignore. "Anomalies" is their explanation.

Being a pragmatist, I tend to go with any theory that helps explain the facts. I try not to get emotionally involved (make it a religious matter), and am open to any other explanations which will also fit all of the facts (and not just ignore them). And Horn does do a good job of sorting out the facts and assembling them into a reasonable theory.

I have no problem with the concept of aliens visiting the earth hundreds of thousands of years ago and doing some biological engineering to provide them with a work force. Or in some aliens still being around behind the scenes, keeping track of and influencing events. Even if you accept the big-bang theory (which I no longer do), the universe is plenty old enough for advanced civilizations to have checked out all habitable planets millions of years ago.

Erich von Däniken wrote about this stuff in the '60s and '70s (*Chariots of the Gods*). As I mentioned a few years ago in an editorial, when von Däniken brought up the subject of the Admiral Piri Riis map and cited a ham friend of mine, Father Linehan W1HWK, the head of the Weston Observatory, as an expert on the map, I visited him to see how well von Däniken had done his homework. I found that the map did indeed show Antarctica as it was without the mile or two of ice on it. Further, as a result of the map, Fr. Linehan made soundings in Greenland, where the map showed it to be two islands, and found the map was right. That was the first time this was known. So where did a map showing an Antarctica and Greenland without ice come from? He said it had been copied from other much, much older maps.

Oh yes, the map is centered from above the pyramids of Egypt. Did you know that the position of Egypt's pyramids and their size is a replication of the stars of Orion and that the "ventilator shafts" in the Giza pyramid pointed toward Orion, Sirius, and the Hyades when it was built?

Well, this stuff is more fun to read about than endless stories of the misdeeds and waste of Congress.

Horn has done a monumental job of researching ancient writings and posits an answer for several major historical changes which have baffled archeologists, such as how man suddenly appeared, with no intermediary life forms having yet been found. And how, after a million years or so as hunter-gatherers, suddenly, in just a few years, man seems to have domesticated plants and animals, making farming possible. Then there was the sudden appearance of towns and cities, which call for major developments in organization.

He also has done a remarkable job of researching the early days of the major religions and explained many things about Christ and Christianity that I never heard in church. This is not stuff that any seriously religious person should read. It's better they don't know.

I liked the way Horn's story ties in with what I've read in several other books on Egypt, the Dogon tribe, Graham Hancock's research, and so on. And Pat Flanagan's work too. He's done a lot of pyramid research. There's a new book out on Flanagan and his inventions by Nick Begich, the chap who wrote the HAARP book, *Toward a New Alchemy*.

Yes, all this flies in the face of what we've been taught in school and church, so perhaps we'll do better if we ignore troublemakers like Horn and believe what we've been taught and can see. Any fool can see that the sun is circling the earth, so no wonder Galileo was given a hard time.

Rejuvenation

A while back an old man was struck by lightning—and survived. It was what happened next that was so surprising. He grew a third set of teeth and a head of new dark bushy hair. His inoperable cancers

Continued on page 33

Simple Mods for the Ramsey FX Transceiver Kit

Customize it!

Peter A. Bergman NØBLX
3517 Estate Dr. SW
Brainerd MN 56401

For those of you not familiar with the FX series kits from Ramsey, they are 12-channel, diode-programmed, FM transceivers with an output in the neighborhood of 5 watts. The series includes rigs for 6 meters, 2 meters, 220 and 440 MHz. The microphone, case and speaker are optional. The theory and assembly manual is all I could hope for. That's where the germ of some of these modification ideas came from.

Mods? For a kit? Why build in the first place? Scratch builders build for several reasons, including the fact that the device they want may not be available at any price. It may be *available* but not exactly the way they want it, or they may want to create something which is uniquely theirs. I suspect that our primitive ancestor who first decided to keep the thighbone s/he had just used for bashing something may have decorated it for the same reason.

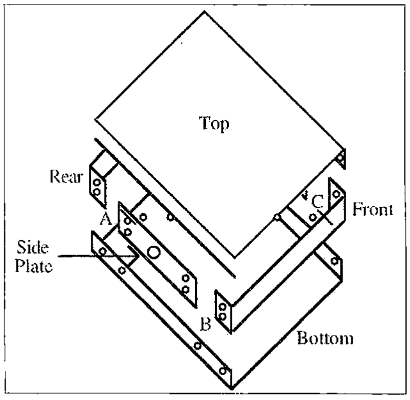


Fig. 1. *Slide switches can be mounted easily at points A, B and C. File notches in the case top to allow free movement of the switch handle. The side plate may need to be shortened slightly.*

Kit building satisfies a large part of that creative urge. Modifying the kit is an even larger step in that direction. Besides, if you built it and it quits working, you have a better chance than almost anyone to make it right again. And it's just plain fun!

On/off indicator

The first change I decided to make to my FX-146 was to install an on/off indicator. I could have wired an LED to the power switch or the wiper of the channel switch but I decided to make it more useful by connecting it to position #1 on the channel selector switch (S2). That's where I've programmed the repeater I monitor 99% of the time. If I see a green light I know that the rig has power and it is tuned to the local repeater. I installed a bi-color LED and connected the other half to position #12, where I've programmed the CAP repeater. Now I have an LED indication that shows if I'm on channel 1 or channel 12. I can count clicks in either direction and know what frequency I'm on—even in the dark, while driving.

A handi-ham suggested that it would be nice if the rig beeped at channel one. I haven't done that to mine yet, but it sounds like a good idea so I might implement that mod in the future.

Reverse polarity protection

The FX kit, as I received it, does include reverse polarity protection. An easy way to provide that protection in a kit or other project is to install a nice hefty power diode backwards between the positive line and ground. When power is connected properly—negative line to ground—the diode will look like a very high impedance—an "open"—and have little or no effect. But, if the leads are reversed at the power source the diode will look like a short and blow the fuse before any damage is done to the rig.

In the December 1994 issue of *73*, Frank Kamp K5DKZ describes another method of reverse polarity protection using a bridge rectifier. If you use his method it doesn't matter how you apply power as the bridge insures correct polarity. Cheap insurance either way.

Non-standard splits

When I bought my FX kit I was assured that it could be programmed for the Civil Air Patrol repeater frequency pair. So when I got to the programming phase of construction I put in 146.52 like the book said. Then I installed the programming diodes for the local ham repeater. So far so good. Then I put in the CAP output frequency of 148.15. Fine. I could hear the repeater. Then I went to the auxiliary line on the matrix and tried to put in the 4.25 MHz split. After considerable study—and hair pulling—I decided that I could get close but not close enough. A couple of phone calls to Ramsey later I'd learned two things. The auxiliary line in the matrix was not set up to be programmed for 4,250 kHz or any other split that could not be divided evenly by eight. And the bits I needed to program that split were there but they were soldered to both sides of the plated-through board at U10, one of the 74HC283s.

A number of alternatives suggested themselves to me but I settled on the cheapest. I used a needle-point jeweler's file to cut pins 6, 2 and 15 loose from the board. They are, respectively, 1, 2 and 4 bits. Then each pin can be tied above ground with a 100k resistor and programming diodes run from each pin to the auxiliary line as needed for your application. It's kind of a combination of the worst aspects of "ugly construction" but mine has been that way for two years and still works fine. If you are absolutely certain that you will never ever want to install a non-standard split just solder U10 to the board. If you think you might, then socket the durned thing so you can get to the pins later.

Access tones

Most Civil Air Patrol repeaters share one frequency pair and require a CTCSS tone for access. I had decided to try using another Ramsey kit, the TD-1 Tone Decoder-Encoder, to generate the access tone for our local CAP repeater.

The TD-1 Tone Decoder-Encoder is a fun little kit all by itself. The board is not much bigger than an Elvis commemorative stamp and only takes a few minutes to assemble, but it comes with a 16-page manual that explains a lot about CTCSS and DTMF tones and gives some ideas about everyday control applications.

All I had to do to get the TD-1 to work for me in the FX transceiver was to add a one-transistor buffer stage and level pot to the basic kit, as explained in the TD-1 manual. Connecting it to the transceiver was a piece of cake since Ramsey plainly marks the points for "PL" input and various points on the transceiver board where I could get the 8 volts to run the tone board.

This gives me one tone which I can turn on and off with a little slide switch. But what if I want more tones? The frequency of the TD-1 is set with a precision pot. How about installing a little sub-board with two or three pots and a front panel switch to select the tones? No, it won't give me access to all the CTCSS tones, but I don't travel much anyway. Ramsey does have a new kit, the QT-1 Subaudible Tone Encoder/Decoder. I've not had a chance to try it out but it is very small and does generate any of the CTCSS tones via switch settings.

You could also hook up a TD-1 as a tone decoder. Then when it is turned on, your receiver would be silenced until someone transmitted that tone. Hmmm. A private line. Wonder what we should call it?

If you are concerned about running out of room on the front panel look around and see if you can find a pair of concentric shaft pots—with an SPST switch. Then you could gang the on/off, volume and squelch controls. That should help make more room for your modifications.

Out-of-band operation

All of the FX rigs are capable of operation outside of the ham bands, where you do not want to transmit without the proper license. A flashing LED installed in the front panel—or wherever you want it—and wired to the appropriate channel-switch position will help you avoid embarrassing little incidents. And visits from the FCC or X-Files. You could make it beep there too.

Channel expansion

When I ordered my FX kit, one of my concerns was that it has "only" 12 channels, so once I had it working, I just had to try expanding it. The method I was looking for had to be cheap—excuse me—thrifty, and fit into the rig with minimum fuss and no external parts. I've seen plans for an interface that allows the user to control the frequency with an external computer and there is a kit available now that moves programming to the front panel, but I wanted thrifty *my way*.

The local club operates a weekly emergency services/test net on the repeater output; if the machine quits we'll know where to meet and what kind of coverage to expect. In fact, once, about 30 seconds into a Skywarn Net the repeater took a lightning hit and went off the air, so I knew I wanted 147.03 simplex, but I did not want to tie up one of my precious 12 channels for it.

Once you have programmed a frequency you have to decide if it is going to be +rpt, -rpt or simplex by installing a diode on the matrix at one of those positions. I installed the diode on the wiper of a double throw switch and ran wires from the contacts of the switch to +rpt and simplex.

I knew before I started that I wanted to program 146.73 and 146.76, and when I looked in the book I saw that both frequencies used the same number of diodes with only one of them being in a different position. I decided that I could use the same switching idea to put two repeater pairs on one channel position. All very elementary to this point, but where do we put this growing number of switches without creating a monster we can't use without accidentally bumping things? The solution turned out to be so simple that I've wondered if Ramsey planned it that way.

If you look at **Fig. 1** you'll see that the Ramsey case is a six-piece clamshell design. In each corner where the pieces come together there is room, with a minimum of metalwork, to install a slide switch. The switches, standard size medium duty DPDT, required a minimum of trimming and filing to fit the case. The mounting ears on the switches are clamped between the case bottom and inner plate and either the front or rear panel mounting ears. This mounting method is very solid and has really stood the test of time here.

You probably won't want to install any accessory switches in the right rear corner near the antenna connector. If you do you might end up feeding RF to some part of the rig that really isn't ready for it and it's hard to predict what the presence of extraneous leads in and around the final will do to your output.

Antenna connector

I'm one of those guys who really doesn't care to use connector adapters. They usually add a bit of attenuation and frequently get lost. So install a BNC connector next to the stock SO239 and wire them in parallel. There is plenty of room and it shouldn't hurt anything.

Conclusion

Naturally, before you install these mods, or any others, it makes sense to make sure the device works the way it's supposed to. If you have absolutely no experience in building there are a number of inexpensive kits that will help you get started. Give it a try.

Both of the kits mentioned above are available from Ramsey Electronics, Inc., 793 Canning Pkwy, Victor NY 14564; phone (716) 924-4560.

Build This Receiver Preamplifier

... and use almost anything for an antenna.

Stephen James Erst W9QHV
17516 SE 96th Court
Summerfield FL 34491

What's happening on the 49 meter band? Is 15 meters open? How about 10? Want to look for beacons on 200 kHz?

If you are like most of us, you don't have antennas for every band. If you are an SWL you probably would like to cover frequencies from 200 kHz to 30 MHz or more, and a half-wave antenna at 200 kHz is almost half a mile long. Don't despair, there is a solution: a high input impedance preamplifier. The preamplifier must have a reasonably high input impedance for random wires, either vertical or horizontal, and a low output impedance to drive today's 50 ohm input impedance receivers, and it must have an adjustable gain from 1 to 20 dB.

Here is a preamplifier that lets you use a short antenna over the range from 100 kHz to well over 55 MHz, with excellent sensitivity. Using a vertical 30-inch piece of number 12 wire, or a few feet of wire laying on the floor, signals which had been barely moving the S-meter were 10 to 20 dB over S9 using the preamplifier, even at 200 kHz.

Construction

This preamplifier can be easily constructed in a few hours, and this will be time well spent. The design utilizes two transistors in a complimentary configuration with feedback to broaden the frequency response and provide the needed, low output impedance.

Fig. 1 illustrates the configuration. Transistor Q1 (NPN) in directly coupled to PNP transistor Q2. Feedback from the collector of Q2 to the emitter of Q1 is accomplished by resistors RF and RA. Because of the high open loop gain of the amplifier the gain of the amplifier is RF/RA, or 20 dB maximum. A 1k potentiometer changes the effective value of RA, resulting in a minimum gain of near unity.

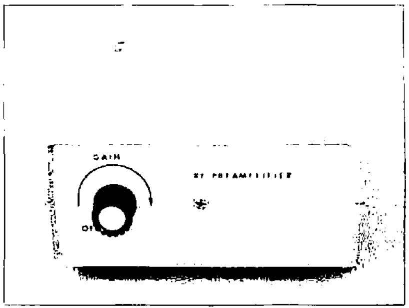


Photo A*. The completed preamplifier unit.*

The amplifier is constructed using a Radio Shack™ perfboard, and is relatively simple. Because of the wideband nature of this amplifier care should be exercised to prevent ground loops, which will cause oscillation. This should be checked using a detector on the output with no signal input. There should not be any detector output with no input signal. A detector configuration suitable for this purpose is shown in **Fig. 2**. Input terminals are provided for coax or a wire antenna and the output uses a BNC connector to connect to the receiver.

The amplifier may use almost any complimentary pair of transistors. I used a 2N3904 for Q1 and a 2N3906 for Q2. If wider bandwidth is desired, a 2N918 and a 2N3546 may be used. Another combination is a 2N2222 and a 2N2907. The pinout for the transistors used is shown in **Fig. 3**.

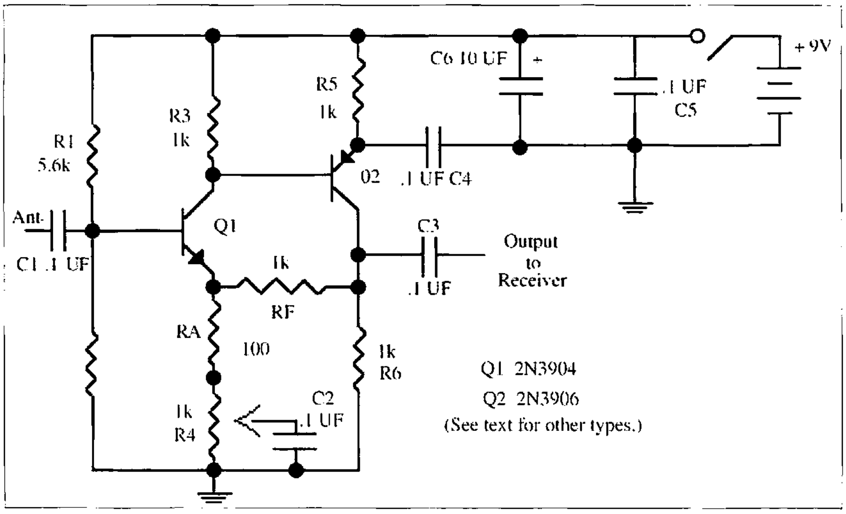


Fig. 1*. Preamplifier schematic.*

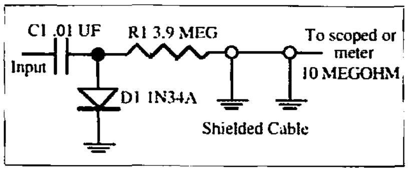


Fig. 2. Detector for checking if the preamplifier is oscillating.

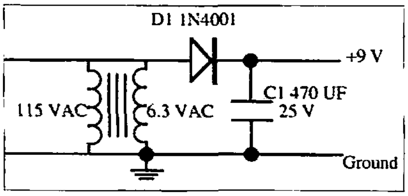


Fig. 4. Suggested AC power supply.

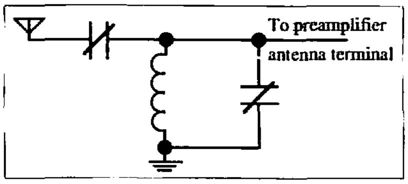


Fig. 5. Preselector for the preamplifier if spurious response and intermodulation are problems. Parts values vary depending on the band.

The 1k gain control may use Radio Shack's 5k potentiometer shunted by 1,250 ohms made up from a 1k resistor in series with 250 ohms. An on/off switch should be used to disconnect the battery.

The operating voltage may be provided by a 9 volt battery or by an AC power supply consisting of a transformer, rectifier and filter capacitor. Regulation is not necessary. A typical power supply is shown in **Fig. 4**.

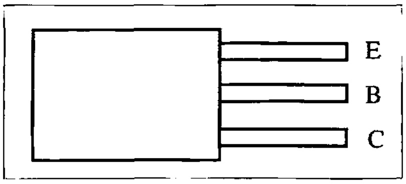


Fig. 3. Pinout of the 2N3904 and 2N3906 transistors.

Because of the broad bandwidth and the high gain of this preamplifier some receivers may be prone to intermodulation distortion and poor spurious frequency rejection due to signal overload. If you experience such problems, reduce the antenna size or preamplifier gain. If you still experience problems, preamplifier preselection may be necessary. To maintain the high impedance of the preamplifier a simple parallel-tuned network with capacity coupling to the antenna may be used. One such network is shown in **Fig. 5**.

The performance of this preamplifier is impressive because of its low output impedance and high input impedance. This project can be completed in a few hours from the junk box or from parts readily available from Radio Shack. Hook it up to a chunk of wire or whatever you have for an antenna and check it out.

Parts List

R1, R2	5.6k
R3, R5, R6, RF	1k
RA	100
R4* (see note)	1k potentiometer, with switch
C1, C2, C3, C4, C5	0.1 µF capacitor
C6	10.0 µF capacitor
Q1	2N3904
Q2	2N3906
9 volt battery	

*Note: A Radio Shack 5k potentiometer may be used, shunted by 1k in series with 250 ohms.

Rechargeable Batteries

The bottom line.

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

The rechargeable battery business is booming today. With the wide-ranging market in amateur radio and business-band portable transceivers (HTs), the portable miniature cellular phone explosion, and now portable laptop and notebook computer systems, rechargeable batteries are found in many more areas of life than ever before. Understanding something about these batteries and their technology has also become increasingly important, so here's a brief primer in easy-to-understand terms.

Mr. Wizard stuff

All batteries work on a similar principle: Current flow between a negatively-charged metallic plate and a positively-charged metallic plate is stimulated by a highly ionized electrolyte, such as an acid. Even a lemon, with its naturally acidic juice, will act as a battery when two plates of dissimilar metallic composition are placed within it. Do you suppose that's where the term "juice" comes from?

Back in the old days

For decades, the only practical rechargeable battery was the lead-acid battery, primarily used in automobiles, boats and airplanes as a storage medium for electrical power. The vehicle's engine, when running, can drive a generator or alternator for recharging the lead-acid battery. Then, about 30 years ago, nickel-cadmium rechargeables came onto the scene and took up some of the market share for portable electronic devices of the time (larger "wet" NiCds were also used in stationary battery back-up applications, but were costly). Lead-acid batteries soon challenged NiCds' dominance in the portable electronics field with a "gelled electrolyte" version. Both battery technologies have had their successes and drawbacks in portable electronics since that time. At present, we also have two newer battery technologies struggling for our attention: nickel-metal-hydride (NiMH) and a rechargeable lithium formulation. Let's take a brief look at all four competing formulations.

Boring definitions

First, a couple of definitions. A "cell" is the basic unit. A number of cells are connected in series so that their combined contributions add together. So a battery's cell is just one unit, and the battery itself is a number of those cells connected in series-additive form. Even though we ordinarily call a flashlight cell a battery, that's not technically correct—you need two or more cells in series to make up a "battery" of cells.

Lead-acid cells

Let's look first at the lead-acid cell formulation. The biggest advantage of lead-acid cells is cost; they're relatively inexpensive to manufacture. Lead-acid cells also can be easily kept up to snuff, charge-wise, with a constant voltage charger, with no ill effects. In fact, they rather prefer that kind of treatment. On the disadvantage side of the coin, however, lead-acid cells are heavy. They have the poorest weight-to-energy ratio of all the battery formulations; lead is heavy stuff! The acid used in lead-acid cells (sulfuric acid) is noxious and corrosive if spilled or if accidental leakage occurs. Other formulations aren't as immediately destructive as sulfuric acid; it can be nasty! Eventually the lead plates in a lead-acid battery become clogged or nonporous (technically called "sulfated") and the cell is no longer rechargeable. Lead-acid cells are usually rated for 500 or more recharges before this happens, but it's also predictable on a time-from-manufacture basis. The "spongy lead" in lead-acid batteries has to be beefed up with the addition of antimony (a brittle, white-colored base metal). Antimony reacts with the acid and eventually contaminates the "spongy lead," so lead-acid cells have a built-in clock once the acid is introduced. When that clock runs out, the cell is unsalvageable. A Happy Motoring Tip: Best not to "push" your car battery too much beyond its life-in-years rating printed on the case.

NiCd cells

Nickel-cadmium cells, on the other hand, have a much better weight-to-energy output ratio than do lead-acid cells. This can be very important to users of today's miniature electronic devices, but these batteries are also more expensive to make. NiCds maintain a relatively constant output voltage as they discharge, whereas lead-acid cells drop off (voltage-wise) more linearly. But NiCds also have a "memory effect" attributed to them. One manifestation of this "memory effect" is when NiCd cells are kept on constant charge: They tend not to deliver their full potential charge unless they're first fully discharged. The way this oddity in NiCds shows up goes something like this: When a NiCd cell is fully charged, its open terminal voltage is about 1.4 volts. As the battery's reserve is drawn upon by the load, that figure drops fairly quickly to 1.3 volts, then to 1.2 volts. The NiCd cell maintains that 1.2 volt level right up to the end of its useful discharge curve, at which point it drops quickly down to 1.1 volts, and then lower... all the way to zero. When that 1.1 volt point is reached the load should be removed, because further discharge can harm the pack. In any pack of six, eight or 10 cells, one or two cells will always hit bottom first, and if the load is

still connected to the pack, current in the reverse direction will be forced through the bottomed-out cells, causing them to reverse polarity. They're usually not salvageable after that happens. Since the drop from 1.1 volts per cell is rapid, "smart" devices will automatically shut down at the point of 1.1 volts per cell, saving the pack from potential harm. The memory quirk mentioned before, however, causes the fast drop-down to occur at a somewhat higher terminal potential than 1.1 volts per cell, so it can be a fooler. The pack (battery of cells) becomes "trained" to expect recharging at a higher point in its discharge curve, and therefore won't deliver as much energy to the load before it "wants" recharging. It's shaken back into reality by one or two deep discharges, carefully monitored so that cell reversal doesn't accidentally occur. So remember that NiCds can become "spoiled" by over-feeding, but it's usually a correctable mistake, even though it's somewhat inconvenient.

It's best to charge NiCds slowly, over 16 to 18 hours, but rapid charging is possible if the cells are built to take the extra punishment. Heat is the enemy of NiCds, and rapid charging causes heat buildup within the cell—it's a sign that the chemical reaction of recharging is taking place too quickly for the cell to handle properly. Rapid charging generally reduces the pack's useful life by 50% or so, about the same as that of a lead-acid battery. It's often an acceptable price for the convenience of rapidly recharging when that option is valuable to the user. When the pack reaches full charge after being rapid charged, a slight discharge can be detected and the rapid-charging turned down to a trickle charge (hopefully).

NiMH cells

A newer alternative to NiCd chemistry is NiMH, or nickel-metal-hydride. NiMH cells have about the same energy-to-weight ratio as do NiCds, but NiMH cells have a much greater energy-to-volume (physical size) ratio—about 25% more. This means that a NiMH cell can be the same physical size (even though somewhat heavier) as a NiCd, and will deliver 25% more energy per charge. NiMH is also more "environmentally friendly" and is sometimes called the "green rechargeable cell." NiMH cells can be charged more quickly than NiCds without loss of potential recharge cycles. They can stand more heat buildup, and, in fact, normally get hotter during recharge than their NiCd counterparts—but that's normal for the NiMH chemistry. They also don't exhibit as much "memory effect" as NiCds do, but there is still some memory retention. The "normal" output voltage per cell is 1.2 volts, just like a NiCd cell. The number of charge/discharge cycles for the NiMH chemistry is about the same as for lead-acid and rapidly-charged NiCds; about 500. They're a bit more expensive to produce than NiCds right now, but the price will no doubt drop as more companies gear up for their production and the NiMH market-share increases.

Rechargeable lithium cells

The highest energy-to-weight power density of all of the formulations is found in the fourth and final formulation, the rechargeable lithium cell. Lithium rechargeables can pack double the energy (in terms of both volume and weight) of NiCds. The specially formulated lithium compound used in lithium rechargeables produces an open terminal voltage of about 3.5 volts per cell. Lithium rechargeables are quite new, and therefore the most expensive to produce, for the moment. Manufacturers are also having problems producing rechargeable lithiums in multi-cell packages, but that also may be a temporary drawback. Lithiums are the most "environmentally friendly" of the lot and they have no "memory effect" at all. Rechargeable lithiums seem to be the technology to watch in the next few years for rechargeable-battery-operated gear.

Non-rechargeable alkaline cells

Just as a comparison: The non-rechargeable alkaline cells that we're all familiar with produce 1.5 volts per cell. Their energy-to-weight ratio is roughly double that of the heaviest of the rechargeables, the lead-acid cell, and about the same as that of a NiCd. Their energy-to-volume ratio (energy to physical size), however, is about the same as lead-acid chemistry, so they're much worse in that respect than NiCds, NiMHs or lithiums (just an interesting aside).

A Positive and Negative Power Supply

A simple one-evening project.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30, c/o Defendini
Salinas PR 00751-0030

Many circuits using operational amplifiers (op amps) require both positive and negative voltages to operate correctly. This is quite common, especially in many direct conversion receivers, active audio filters, function generator circuits, etc. Most commercial power supplies produce only positive voltages, usually just +13.8 VDC, so you're going to need a simple power supply to solve this problem.

Some hams solve it by connecting two 9 volt batteries in series with the connection between them becoming the common, usually ground, terminal. While this does produce ±9 volts, these batteries are not only expensive, but have to be replaced periodically. When something stops working right how long will it take you to find it's a pooped-out battery?

The simple power supply described here produces not one, but two different positive and negative voltages, and requires only eight inexpensive components in addition to the small power transformer. The total cost should be no more that what you would pay for one or two pairs of 9 volt alkaline batteries, and can probably be constructed entirely from the contents of your junk box.

Because most circuits requiring split positive and negative voltages draw very little current, and usually do not require specific voltage levels as long as the voltages supplied are within device specifications, simple rectifier/filter circuits providing unregulated output voltages can normally be used satisfactorily. However, where specific voltages are required, such as +12 and -5 volts, small 100 mA three-terminal regulators can easily be added to the basic circuit.

The circuit

The basic circuit for this dual, split-voltage power supply is illustrated in **Fig. 1**. The addition of regulators, if required, is illustrated in **Fig. 2**.

A small power transformer with a center-tapped secondary is required if two sets of output voltages are required. If only a single pair of positive and negative voltages are needed, no center-tapped secondary is needed. If you use a center-tapped transformer, you can use either half, both halves

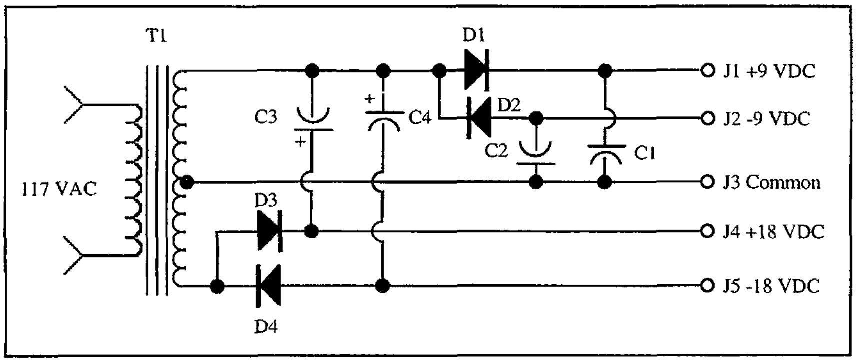


Fig. 1. Unregulated power supply schematic. All capacitors are 1000 μF, 25 WVDC. All diodes are 1N4001 or equivalent.

separately, or the full secondary, depending upon the needs of the circuits to be powered.

The basic circuit uses four half-wave diode rectifiers and four filter capacitors, and will produce two sets of positive and negative voltages. One, using the full secondary, is twice that of the other, which uses only half the secondary. This provides considerable leeway in selecting a suitable voltage pair. It also allows regulating either or both voltage pairs, using the small 78LOxx and 79LOxx regulators.

Terminal J3 is common to both voltage pairs, and although normally connected to ground, it can be left floating if you want. However, it must be connected to the "common" in the circuit being powered.

The voltages given in **Fig. 1** are nominal voltages derived from using a 12 VAC center-tapped secondary of transformer T1. J1 (positive) and J2 (negative) provide ±9 VDC referenced to J3, common. Likewise, J4 (positive) and J5 (negative) provide ±18 VDC referenced to J3.

"It's almost impossible to wire this circuit wrong—but Murphy's always lurking nearby."

These voltage are nominal, with no load current being applied, and with 115 VAC applied to the primary of T1. There may be slight variations from these nominal values measured from your supply.

Construction

There is nothing critical in lead lengths nor component placement. It can be constructed in any type enclosure, or even on a breadboard, but watch out for the AC input terminals. You can build it into the equipment in which it will be used. You may also eliminate T1 by building it into your station power supply, using its power transformer for a source of low voltage AC to the rectifier/filter circuits. However, if the station power supply incorporates a bridge rectifier this may not be possible because of potential voltage differences between power supply negative, and common in this circuit.

Be absolutely certain you observe the polarities of diodes and filter capacitors, and double-check these before applying power to T1. A filter capacitor connected backwards can destroy its associated diode, and can also explode! An incorrectly installed diode will apply reverse voltage to its associated filter capacitor, with similar fireworks.

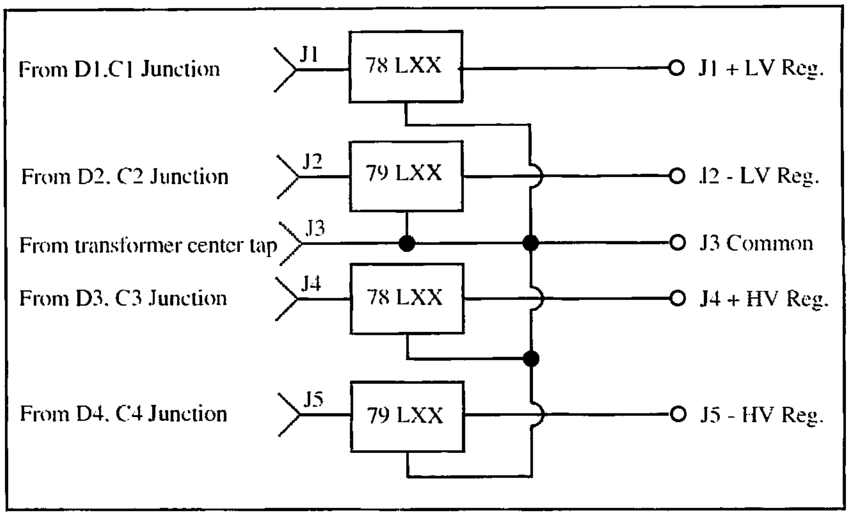


Fig. 2. Adding three-terminal regulators to the basic supply circuit.

Also note the connections to the 78LOxx and 79LOxx regulators, which are different from each other, if these are needed in your application.

Although not shown in **Fig. 2**, you may wish to bypass inputs and outputs of each regulator to enhance stability and to eliminate any hash impressed on the DC voltage rails by the circuits being powered, which could interfere with proper regulation. In this application, 0.1 µF bypass capacitors should be sufficient.

Remember to return J3 common, to which the bypass capacitors are returned, to the common in the externally powered circuit. Usually this will be the DC ground, in which case the bypass capacitors should be returned to the nearby chassis ground, as would J3.

Although the example illustrated in this article provides a nominal ±9 VDC and ±18 VDC, which should suffice for most circuits requiring a split voltage supply, a center-tapped secondary of 24 VAC will produce nominal ±18 and ±36 VDC.

Caution

A transformer supplying more than 12 VAC will produce peak voltages exceeding the diode peak inverse voltages and capacitor working voltage of those specified. In this case, substitute components which will withstand higher voltages.

Because circuits requiring split voltages for proper operation draw only a few milliamperes normally, a very small and inexpensive power transformer can be used for T1. A transformer with a 12 VAC center-tapped secondary rated at 100 mA or more should be sufficient. Just be sure the secondary is center-tapped if you want two sets of split voltages.

Here is a rule of thumb which, if applied in every case, will save a lot of problems in the future: Every time a supply voltage enters or exits an enclosure, bypass inside the enclosure, using a 0.001 µF, 0.1 µF and 10 µF electrolytic capacitor in parallel. These capacitors, acting in concert, will strip the DC lines of any hash generated within or external to each enclosure.

Operation

Check the voltages between J3 and all output terminals before using the supply to power other circuits. Although it is almost impossible to make a wiring error in a circuit this simple if care is taken to correctly orient the diodes and capacitors with respect to their polarities, Murphy is always lurking nearby. So be *sure* before you apply power.

If the four voltages and polarities measured are not similar to those given here, turn it off and see what you've done wrong. Look for poor solder connections and reversed polarities. Replace any components installed in reverse with new ones, just to be sure since they may have been damaged. Feel the diodes, if they are warm look

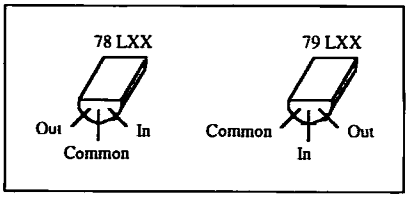


***Fig. 3.** Pinouts for the common positive and negative low current regulators.*

for possible shorts. The associated filter capacitor might be leaky and need to be replaced. Check also for any shorts to common.

If you do not regulate the output voltages, you may notice that there is a slight difference between the voltage levels in the pair being used. This is normal and reflects the different current requirements of the circuit being powered. If the circuit functions correctly don't worry about the voltage differential, which is usually of no consequence. But if it really bothers your sense of perfection, add regulators.

When adding regulators, remember that they require head space—higher input voltages than the desired output voltages. The 9 VDC rails can be regulated to 6 volts or less, and the 18 VDC rails can be regulated at 12 volts or less, and possibly even at 15 volts in most supplies.

You may be tempted to use zener diodes as regulators. I don't recommended this because they will cause additional current drain, and the diode and its dropping resistor have to be matched to the current required by the external circuit. This limits the universality of uses for which this power supply was designed. 73

Parts List

C1-4	1,000 µF 25W VDC (minimum) electrolytic capacitor
D1-4	Rectifier diodes; 1N4001 or equivalent
J1-4	Terminals, your choice
T1	Transformer, 120 VAC to 12 VAC center-tapped, 10 mA or greater

NEVER SAY DIE

Continued from page 23

disappeared. He no longer needed his glasses or cane and was completely healthy and looked years younger, much to the bewilderment of the doctors who followed and documented his progress.

It may be that the doctors at the Albert Einstein College of Medicine in New York have accidentally tapped into this fountain of youth in their AIDS research. They've patented the process, as have several other hospitals, but there's no word in the medical literature (or the press) of these hospitals using this blood purification system to cure AIDS. One might wonder why the silence. Well, that would be someone who has not done his homework and read about a long string of other remarkable discoveries which have been given a similar treatment by the medical industry.

Are the growing number of miracle cure reports from people using the Miller Bioelectrifier or the Beck "plant growth stimulator" true? Is this simple, inexpensive, and fairly fast process really curing virtually every cancer case it's been tried on? Is it curing AIDS? Lupus, Lyme Disease, and a host of other illnesses? Is it really causing people to lose weight and grow new hair? Is it giving them industrial-strength immune systems which are able to fight off colds, flu, and anything else "going around?" That's what the medical review board reports are showing. How soon will we be able to see some research hospitals fight off the pressures from the AMA and give this approach a rigorous test on Alzheimer's, cancer, osteoporosis, arthritis, diabetes, and so on? Is the Department of Health totally anesthetized?

For that matter, considering the potential, have you heard one single politician say word one about this medical discovery? They don't dare without jeopardizing their lobbying money from the AMA, the doctors and nurses organizations, the hospitals, drug manufacturers, and the insurance industry. The higher our medical costs, the bigger the insurance company buildings and hospitals will grow.

Why am I not surprised, considering the corruption in every industry I've gotten to know personally or read much about? The amazing thing would be if the $1.5 trillion medical industry weren't corrupt.

Cesspool

Gee, I hate to bother you about this, but our 20m cesspool on 14,313 is alive and stinking. Yes, I wasted some time listening to one of our biggest public advertisements for the elimination of our hobby. There was one old man on there with a strong signal, prattling on endlessly about showing Saddam Hussein a lesson. He was cursing freely and showed no indication that thought had contributed anything to his opinions. Other strong voices were breaking

Continued on 55

Number 35 on your Feedback card

HFx from Pacific Sierra Research Corporation

New propagation forecasting software.

Richard Lubash N1VXW
rlubash@poco.mv.com

As I start writing this review it has been 36 days without a single spot being sighted on the face of the sun. The last time old Sol had such a long period without blemishes was 1944, two years before I was born. We are indeed in the midst of the solar doldrums. At a time like this, a little magic or a crystal ball sure would come in handy—just that extra edge so you could find that lone DX station up on 20 meters that hasn't shown up on the cluster. With so many bands and so little time, it sure would be nice to know where to look. Or maybe you have a buddy in Shiprock, New Mexico, and would like to set up a sked on 17 meters but due to low flux levels haven't been very successful. Well, what you need is some good propagation software for that computer sitting on your bench waiting to log a contact.

Pacific Sierra Research Corporation, out of Santa Monica, California, thinks they may have the answer for you with their new propagation forecasting software, HFx. I know, you think "propagation software" and your mind pictures arcane DOS programs that governments use to find out just when to flood an unsuspecting country with shortwave broadcasts or get that super-secret message through. There are a number of these programs floating around and the key phrase for them is *not* intuitive. Well, HFx is a Windows-based application that is designed around the concept of point-and-click. Out of the box I found myself being able to play around with HFx, though it's true power can't be unleashed until you read the well-written manual.

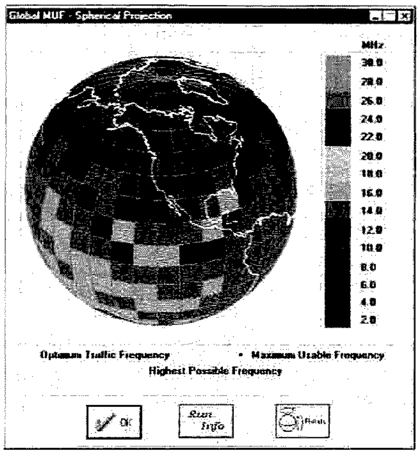


Fig. 1b. Spherical global view of Maximum Usable Frequencies for transmitter location, date and time. This view can be rotated on either axis.

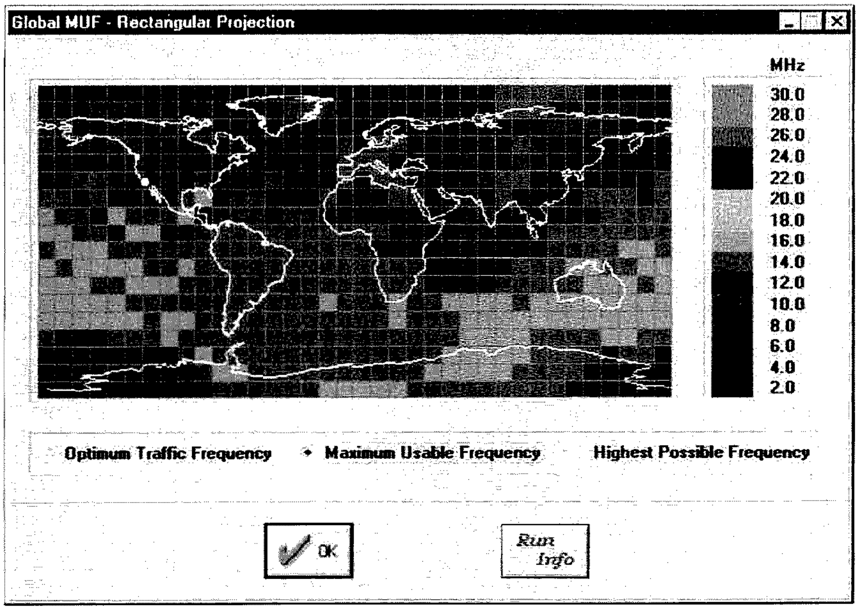


Fig. 1a. World view showing Maximum Usable Frequencies for transmitter location, date and time.

What is HFx?

HFx is a powerful HF propagation tool that calculates ionospheric skywave signal strength from 2 to 30 MHz. HFx uses a very intuitive graphical user interface that heavily supports point-and-click and bases its operation on virtual-raytrace algorithms developed by ITS and CCIR over the last 30 years. The software creates three distinct output models designed around user input of:

- The geographic position of both transmitter and receiver
- Emission power and antenna characteristics
- Date and time
- Propagation path (long or short)
- Solar flux or sunspot number and K index

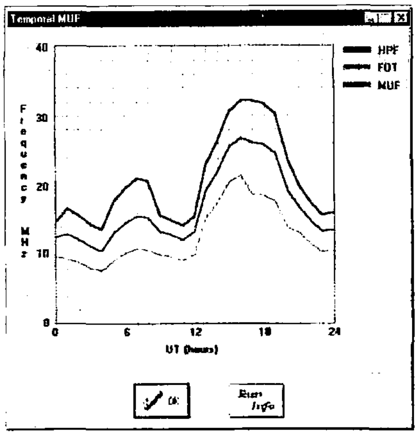


Fig. 2. Highest Possible Frequency, Maximum Usable Frequency and Optimum Traffic Frequency plotted between transmitter and receiver for a 24-hour period.

After you input the above information via dialog boxes or by point and click on a world map, HFx will give you the following models:

•Global MUF, which is displayed by user choice on a flat or spherical world map that can be configured for Highest Possible Frequency, Maximum Usable Frequency or Optimum Traffic Frequency. (See **Figs. 1a** and **1b.**)

•Temporal MUF, which consists of a 24-hour graph plotted for a path between the transmitting station and receiving station with frequency versus UTC time for Highest Possible Frequency, Maximum Usable Frequency or Optimum Traffic Frequency. (See **Fig. 2.**)

•Hop Mode, which provides both a graphic representation of the hop path between transmitter and receiver, and a plot of availability and signal-to-noise ratio for the HF amateur bands 80-10 meters during a 24-hour period. (See **Figs. 3, 4** and **5.**)

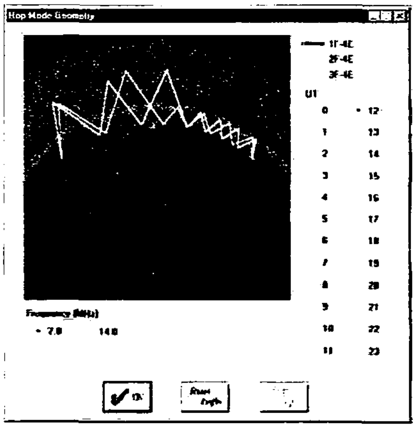


Fig. 3. Hop path for transmitter and receiver on 40 meters at 1200 UTC.

HFx system requirements are a little more robust than the typical hamfest junker PC, but with many hams upgrading their systems running it should not prove too great a challenge. Minimum configuration is:

386-based PC
Windows 3.1 or higher, including Windows 95
Hard drive with 6 megabytes of free space
3.5" floppy drive
4 megabytes of free RAM
Mouse
SVGA monitor set to 256 colors at 640 x 480

> ***"HFx is a powerful HF propagation tool that calculates ionospheric skywave signal strength from 2 to 30 MHz."***

Operation

The main operational window consists of a world map and two tool bars which provide access to all of the features incorporated in HFx (see **Fig. 6**). The map can be configured to show transmitting and receiving station placement, solar position, major world cities, great circle path between Tx and Rx, auroral boundaries based on geomagnetic activity and day/night terminator. The window can be resized via the mouse and the world view will automatically resize to the new window position with no need for scrolling. The system comes with an extensive online help system that mimics the well-written and illustrated manual. Political and state boundaries are not shown on the world map but dialog boxes allow entry via a scrollable list of call prefixes so that placing the transmitter and receiver can be accomplished without the aid of a world atlas.

After playing with HFx for a few hours you can enter data and get results in a matter of seconds, and it becomes fun to see what the software says about the possibilities for the QSO you are currently having. I decided to give HFx a shakedown by comparing its predictions with the actual contacts being made during the '96 CQWW RTTY and CQWW SSB contests. I decided to not only test it against stations that I heard from my QTH but also against station sightings that came in on the DX cluster during the contest. I was able to set up the transmit locations on cluster spots using the latitude and longitude information from a callsign CD ROM, and used the scrollable list of callsign prefixes on HFx for the DX station location. In addition, I used HFx to set up a number of skeds with stations here in the US based on optimal times predicted by the software.

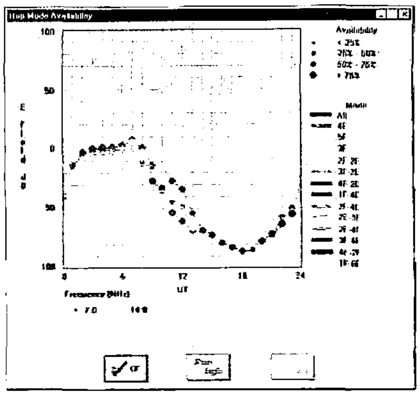


Fig. 4. Hop mode availability for transmitter and receiver on 40 meters over a 24-hour period.

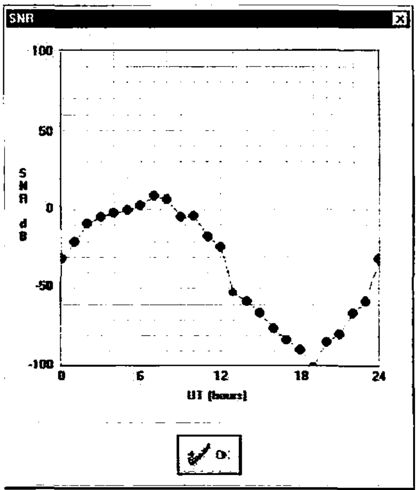


Fig. 5. Signal-to-noise ratio for transmitter and receiver on 40 meters over a 24-hour period.

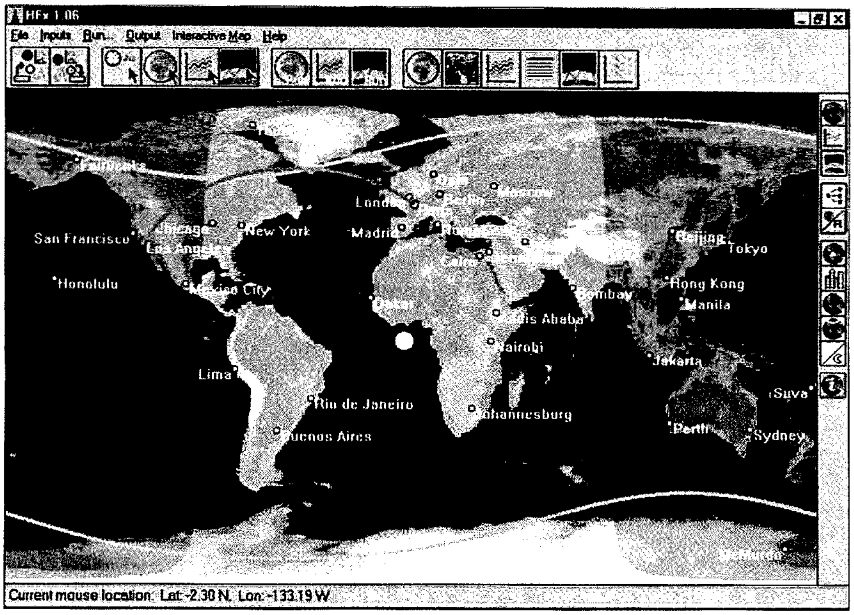


Fig. 6. Main screen, showing transmitting and receiving station placement, solar position, major world cities, great circle path between Tx and Rx, auroral boundaries based on geomagnetic activity and day/night terminator. These items may be turned on or off at user's discretion.

Conclusions

The results of my unofficial field testing were quite amazing. HFx was able to predict that communication should have been possible for recorded DX spots the vast majority of the time. In many cases, HFx showed a small window of opportunity at the Maximum Usable Frequency and, sure enough, spots would start showing up on the cluster. I also checked HFx against my station log randomly over a period of about six months and the vast majority of contacts fell within the plotted window of opportunity. I found the hop mode to be quite educational in that it gave a graphic representation of the signal path, availability and signal-to-noise ratio.

"I do like technology and, like most hams, I love toys; HFx fits both requirements."

I enjoyed using HFx. I don't have a "big gun" station and probably never will, but I do like technology and, like most hams, I love toys. HFx fits both requirements. I would like to see the next release of the software include a display of Lowest Possible Frequency and possibly dynamic real-time entry of the time at the transmit location, but for now I think the folks at Pacific Sierra Research Corporation have a winner.

Although it would take a serious amount of research with both transmit and receive stations available at different times, places, times of the year, and solar conditions to thoroughly test out any propagation software, I found the results that HFx produced for both my contesting experiment and setting up skeds to be quite impressive. One should understand that any propagation program just collates past statistical data in the hope of applying it to the future, which is never entirely predictable. Using propagation software does, however, give one a place to start when turning on the rig and wondering where that DX might be lurking or when the best time is to call that friend on the other side of the country. The little bit of magic that a program like HFx can perform sure can't hurt, and, after all, doesn't amateur radio involve just a little bit of magic?

Availability

HFx is priced at $129. If you are on the Internet you can get product information, order HFx or download a demo copy of HFx at: <http://www.psrv.com/hfx/>. Or, contact the company directly: Pacific Sierra Research Corporation, 2901 28th St., Santa Monica CA 90405-2938; (800) 820-4PSR, (310) 314-2300 outside US and Canada.

73 Review

MultiFAX® AM/FM WEFAX Demodulator

Fine-tuning a satellite tracking system.

Larry R. Antonuk WB9RRT
P.O. Box 452
Marlborough NH 03455

I had spent the last several weekends working on my overall weather satellite Automatic Picture Transmission (APT) receiving system. My Hamtronics R139 was built and working well. The Woodhouse Communications Turnstile antenna was assembled and mounted on a tripod on the roof, along with my LNG-137 preamp. I was receiving weather satellite transmissions left and right. Unfortunately, most of the passes I received were coming in totally randomly. I was simply recording everything that came in, and laboriously sorting through the pile later. This worked, but it took several minutes to watch each image paint itself on the screen—only to find out, in some cases, that it was a totally uninteresting shot of some clouds out over the ocean. Since I was primarily interested in the weather occurring in my own general vicinity I found that I was wasting an awful lot of time. It was time to do some homework on my new demodulator.

I purchased my demodulator based on recommendations from a couple of knowledgeable friends, rather than on my own understanding. Once I had my weather receiver up and running well enough to hear anything, I fired up the demodulator and learned enough about it to demodulate pictures. Then I went back to improving my antenna installation. Now that the antenna was installed I had time to fine-tune the final part of the system.

My demodulator was the external demodulator unit from MultiFAX®. This demodulator works in conjunction with MultiFAX's MFMAP Version 7 software, providing a means to decode several types of weather satellite images. I was new to the satellite image business, and wasn't sure exactly what I might be wanting to decode—either right now, or in a year or two. The MultiFAX unit supported NOAA, Meteor, GOES, Meteorsat and HF WEFAX. I had also chosen the MultiFAX because it comes in an external version—I didn't have to tear my PC apart to install a card, and I could easily use the external unit with my laptop. (Of course, the MultiFAX does come in a PC card model for the diehards.) The MultiFAX hooked up via the PC's printer port for full parallel data operation. I knew that some units only used the serial port, which limited their overall data throughput. (I had certainly learned this with my experiences with the home-brew, shareware-supported demodulators.) Another necessity was the ability to record satellites unattended—I certainly couldn't be home to fire the software up in the middle of the day.

What little knowledge I accumulated had easily taken me to the point where I could decode and display images. The installation of the unit itself and the MFMAP7 software was a cinch—just plug the box into your computer with the supplied cable, copy the files from the disk, and hit the road. MFMAP7 takes up about 800 kilobytes on your hard drive, but you'll need about 4 MB total available space. A complete satellite pass gets "recorded" to the hard drive in real time, and takes as much as 3.5 M per image! About the time I decided I needed to learn more about the MultiFAX unit I also found out I needed to do something about the couple of dozen 3.5 MB files on my hard disk—things were getting pretty crowded!

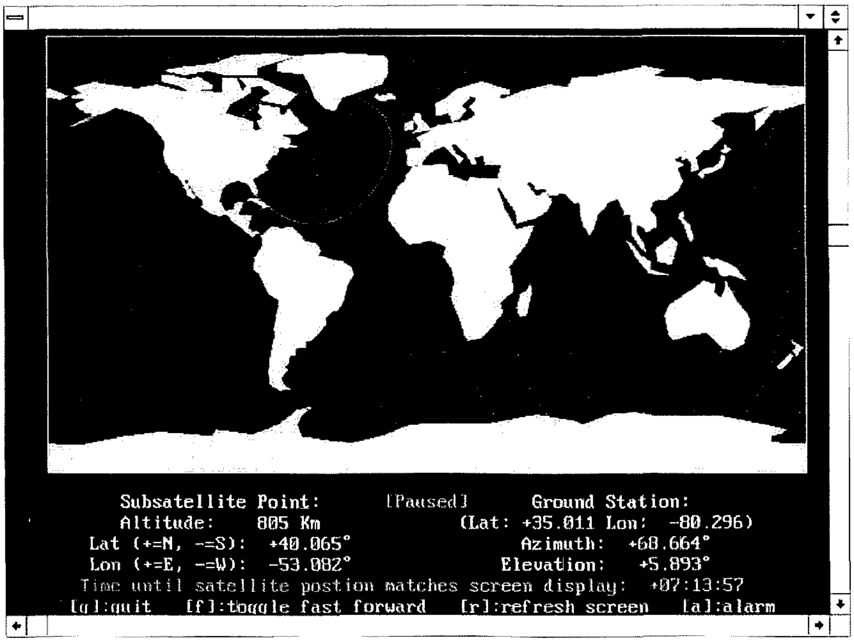


Photo A. MFMAP7 provides a real-time graphical display as it plots satellite locations.

Using it? Simple!

At this point I decided to read the manual, which, in retrospect, was not a

bad move and perhaps should have been attempted earlier on in the game. To begin with, I found that there was no reason to save all of those fat files on my hard drive. The MultiFAX software uses three main types of files. The first type is a Picture file. This file is a complete data recording of the entire satellite pass, and is the 3.5 MB file discussed earlier. This file is recorded from the pass, or the tape recording of the pass, and stored to disk. Once stored, the image is called up using the Display menu of the program. The display menu lets you zoom in and out, invert the image, change the brightness and contrast, and perform various types of image enhancement. Once the image is modified to provide the best picture, you can save it as a View file. A View file is saved in binary format, and consists only of the interesting information cropped from a Picture file. This lets you save just the valuable information from each image, and not use up disk space with useless images. The third file format is the common .GIF format. Either the View or Picture screen lets you output the image to a .GIF file that can be easily used in desktop publishing programs or printed out.

Once I determined that there was no need to be hoarding those huge Picture files, the process became much simpler. To record a file, you simply select the Record option from the Main Menu. This lets you give a filename to the image you are about to record. At this point MFMAP7 displays a graphic signal level meter. This would more accurately be called an on-screen oscilloscope. The meter is a display that shows the relative "brightness" level of the received signal for its entire trace across the screen. A too dark signal will be seen as compressed near the bottom of the display, while an overly white image will be seen crowded near the top of the display. It's a simple matter to adjust the output control of the MultiFAX unit to correct the image, providing a proper range of contrast for the image—before you even start recording. Once the contrast is adjusted you simply hit any key, and the MultiFAX goes into AutoStart mode. This mode synchronizes on the left edge of the image, so the recording will start at the proper time to create the image properly aligned with the screen. (Of course, if for some reason the signal is lost and the image starts recording with the edge going down the middle of screen, the situation is easily corrected once in the Display menu.) As the unit records, the image is traced out to the screen a line at a time, over the next several minutes. A keystroke stops the recording, saving as much of the image as has been recorded up to that point.

The recorded image is then called back up in the Display menu. This menu allows zooming in and out, inversion of the image, changing of the brightness and contrast, false colorization, and a variety of other functions. A section of a Picture is saved as a View, which takes up only a few hundred kilobytes of disk space.

Scheduling the recording

After the novelty of satellite imaging wears off, you'll find yourself not necessarily wanting to record every single bird that passes within earshot. You'll probably want to tailor your recordings to capture just passes that go right over your location, or perhaps you want to capture all the images you can—but just in the three hours before Saturday's ball game. In this case, the Record menu offers a timed function that will start recording a single image at a specific time, based on your computer's clock. In addition to this "wait until recording" mode, MFMAP7 also includes a utility that allows use of a separate schedule file, and will call the Record module at specific times. Using the feature you can record up to 200 passes automatically—as long as you have about 700 MB of space available on your hard drive!

But how do you know when the satellites will be coming over so you can set the timer properly? Luckily, MFMAP7 has a built-in satellite tracking function. This uses a graphical display that shows a world map, and traces the path and footprint of each of the satellites. This display works in both real and accelerated time, so it is very easy to see what will be visible from your location for the rest of the day. The software even tells you the number of hours to wait until the next pass of the selected satellite. Of course, as with all tracking programs, you'll need to download the Keplerian elements on a regular basis so the program can fine-tune itself. These are available from the MultiFAX BBS or via the Internet. The satellite tracking feature of MFMAP7 supports the Kansas City Tracker system, meaning you can have the software automatically adjust your antennas for you as the satellite passes over.

Once you have the proper images recorded, the MultiFAX software supports grid and map functions that allow the user to overlay latitude and longitude lines, as well as map information. More advanced "frosting on the cake" features include the ability to create pseudo three-dimensional images, colorization based on temperatures, infra-red optimization to allow temperature data to be read directly from an image, and even animation. (Yes, you can produce your own moving cloud images just like on the six-o'clock news!)

The MultiFAX WEFAX Demodulator, combined with the Hamtronics R139 receiver, and the Woodhouse Turnstile antenna, has proved to be a very satisfactory weather monitoring station. However, even with all the resources available, including one's own "eye-in-the-sky," I still find myself occasionally getting outsmarted by the weather. I suppose this is simply Nature proving that she's superior to technology, and may never change. Until it does, I still keep an umbrella in the trunk. For more details contact: MultiFAX®, 321 Mason Road, Fairport NY 14450; Telephone (716) 425-8759; FAX (716) 223-6198; BBS (716) 425-8759.

An Enhanced Automatic Voltage Controller

Make this project even more useful.

Sam Ulbing N4UAU
5200 NW 43rd St.
Suite 102-177
Gainesville FL 32606
E-mail: n4uau@afn.org

I try to read all the projects published in the amateur radio literature, especially those in *73* and *QST*. There are many neat ideas in these articles and sometimes if I find a project I can use in my shack, I'll build it. Even if I don't build the project, it is fun to see the different solutions people offer to solve a problem. I have learned a lot about electronics just trying to understand how the different designs work, and I like to design projects myself, so I am always looking at a project to see if I can think of a different (and possibly better) way.

I recently read "Automatic Voltage Controller" (*73*, August 1996). It seemed like a great project and was one I wanted to build. I have had firsthand experience with voltage

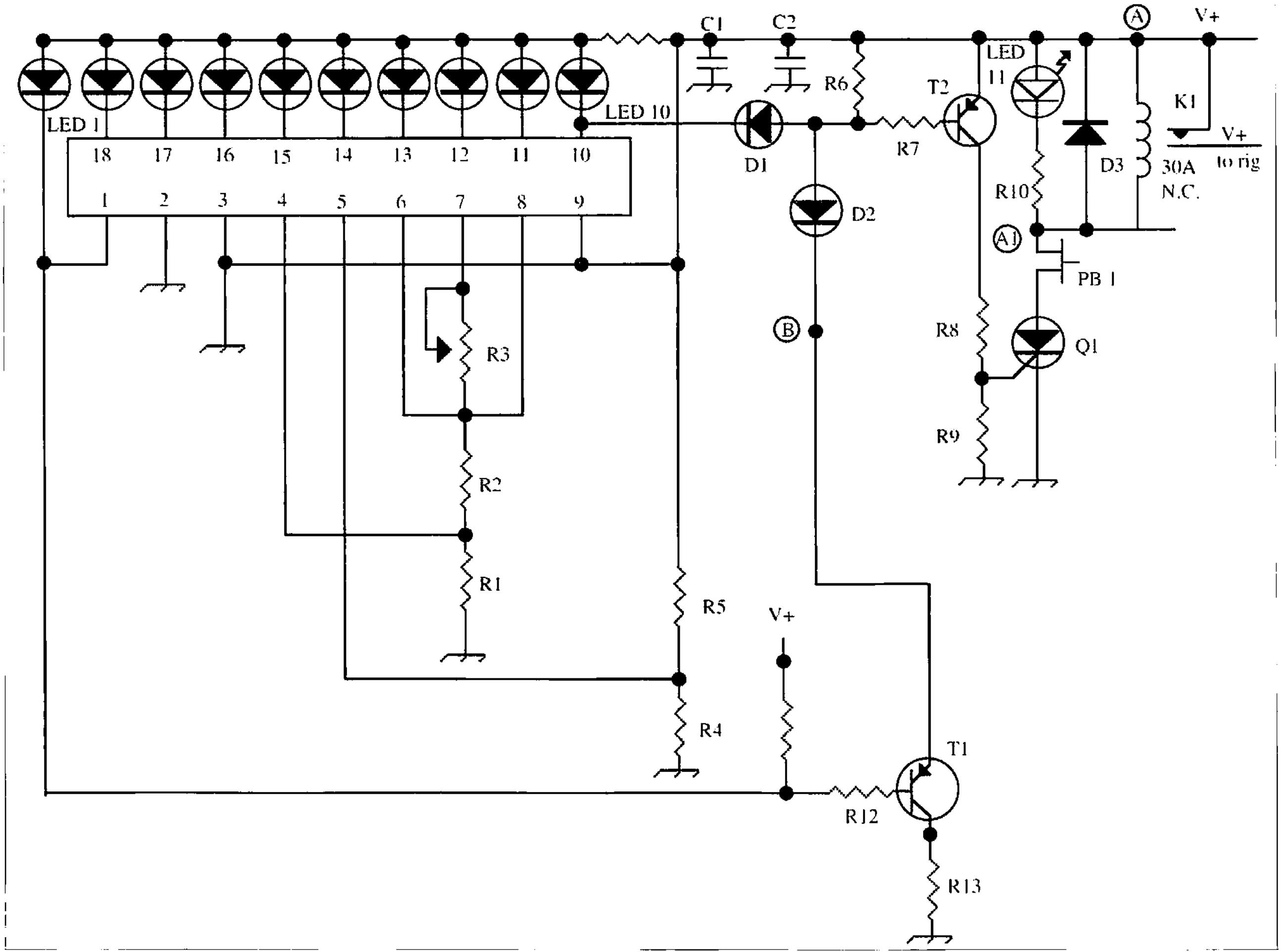


Fig. 1. Schematic for the modified Tiny Tic-Tac Tester (left) with the enhanced voltage controller (right).

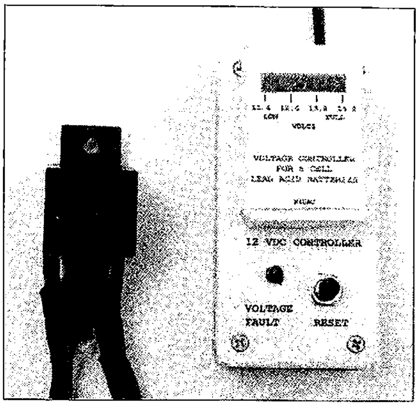


Photo A. Enhanced Automatic Voltage Controller with remaining 40 amp relay.

out-of-range problems. I use an IC-735 on my sailboat when I cruise, and like all sailors, I never seem to keep my batteries fully charged. One day when transmitting, the rig just shut itself down. Eventually I got it restarted but it was not the same. Evidently the low voltage had ruined one of the ICs in it. That turned out to be a $100 learning experience. Is it any wonder I was interested in this project?

Enhancements to the AVC

After thinking about the project for a few days, I decided I wanted to enhance it. The project shown uses zener diodes to set the upper and lower voltage control levels, which works fine but doesn't let you see what the actual voltage is during operation. You may recall I wrote a project article for *73* in March 1996 ("The Tiny Tic-Tac Tester") that was based on an LM3914, which accurately displays voltages. I wanted to add this feature and use it to control the relays as well.

Another feature I thought might be useful was latching relays. Low voltage often occurs when you are transmitting. When you stop transmitting, the load decreases and the voltage increases. With the original design, the AVC would turn on again; indeed, it seems possible that the relays would chatter on and off. I wanted to have those relays trip and stay tripped until I was able to correct the problem.

Finally, I wanted to eliminate as many of those mechanical relays as possible and use electronic relays. My enhancement eliminates two of the three relays.

The design

Fig. 1 shows my enhanced controller schematic. I have drawn it in two parts. The left-hand side is the same circuit used in "The Tiny Tic-Tac Tester," with R1, R2 and R3 set for a voltage range of 11.4 to 15.0 volts. A

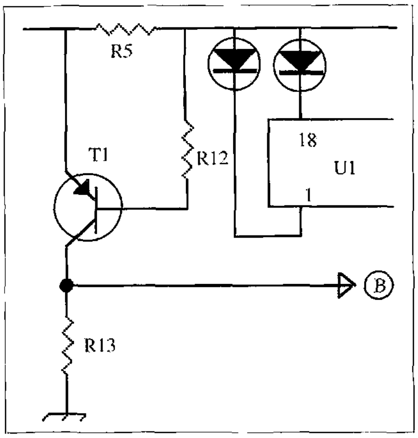


Fig. 2. Modification for dot mode display. Connect T1 as shown. Note: R11 is not used.

complete description of this circuit is given in the original article. Briefly, the supply voltage is divided down by R4 and R5 and fed to pin 5 of the LM3914. R1, R2 and R3 are used with the onboard voltage reference to set the low voltage limit at pin 4 and high voltage limit at pin 6. I tied pin 9 to V+ to get a bar mode display for this project. When the supply voltage is less than 11.4 volts, all LEDs are off. As the voltage rises from 11.4 to 15 volts LEDs turn on from left to right. The higher the voltage the more LEDs are on until at 15 volts all the LEDs are on. With 1% resistors for R1 and R2, this is an accurate expanded scale voltmeter. I set R3 for an LED current of about 4 mA to limit the power that LM3914 would have to dissipate. It would, of course, be possible to use the dot mode instead of the bar mode, requiring only a small design change for the low voltage input (see "Alternative Circuits" below).

While an LED voltmeter may seem obsolete when fancy digital voltmeters are readily available on the surplus market, the LM3914 offers a feature no digital meter can. It can be an active part of the circuit, allowing it to control the circuit, as well as displaying the voltage in a passive fashion. To see how this works, note that I have attached a wire from the cathode of LED #10 (the one that turns on when the voltage reaches 15.0 volts) to the base of transistor T2. When the supply voltage reaches 15.0 volts, the LM3914 turns on LED #10 by allowing current to flow from its cathode to ground. When it is off, the LM3914 does not let current flow. Because T2 is connected to the cathode of LED #10, current will also flow from its base to ground so T2 turns on when the LED turns on. So with just one additional wire the LM3914 can turn on a control transistor when the voltage reaches 15.0 volts.

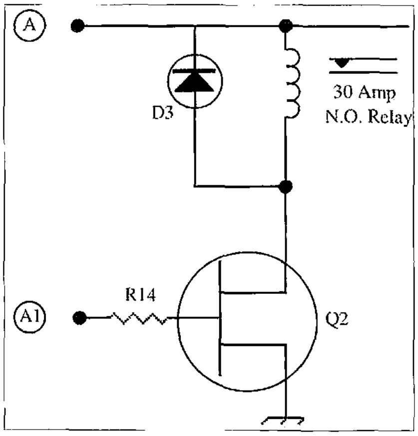


*Fig.3. Modification to use NO relay. Replace NC relay between points **A** and **A1** in **Fig. 1**, with circuit shown.*

The other control point is when the voltage falls below 11.4 volts and LED #1 turns off. This is done the same way except that I wanted to turn on T2 when LED #1 turns OFF rather than when it turns ON. T1 is used to invert the effect of LED #1. When LED #1 is on, current is flowing from its cathode to ground, and because T1 is connected to its cathode, T1 is also turned on. This puts V+ across R13, and therefore on the base of T2, preventing current flow from the base of T2. When LED #1 shuts off, T1 shuts off and the voltage across R13 goes to zero, which lets current flow from the base of T2 to ground, turning it on.

The diodes D1 and D2 prevent interaction between LED #1 and LED #10 and make control of T2 an "OR" operation. If LED #1 is off *or* if LED #10 is on, T2 turns on.

With the LM3914 voltmeter now turning on T2 at the limits I set, I needed T2 to trip a latching relay. Q1 is that relay. Q1 is an silicon-controlled rectifier (SCR). One characteristic of an SCR is that when it is turned on (conducting) it will continue to conduct until the current through it stops. In other words, it is latched on. The gate of Q1 is used to turn the SCR on. When T2 is off, no current flows through R9 so Q1's gate is at ground and Q1 does not conduct. When T2 turns on, the gate is pulled high and current flows through Q1, energizing relay K1 and opening it. The only way to close the relay is to stop the current through Q1. Push-button PB1 does this reset job. LED #11 indicates that the circuit has tripped.

That's all there is to it! The circuit draws about 25 mA when it is in standby (depending on how many LEDs are on) and 200 mA when it trips the relay. Not much power—and *that* can be reduced by using the dot mode display if you desire. See below.

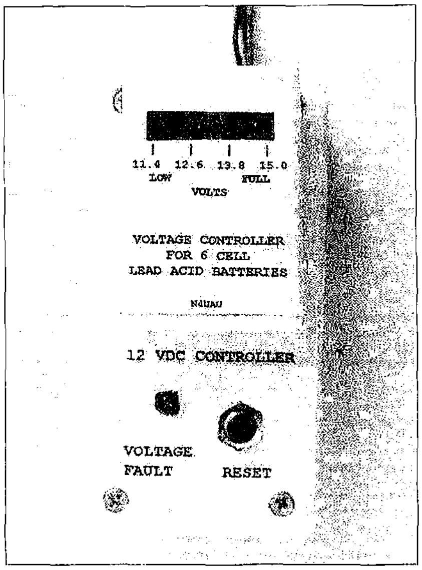


***Photo B.** Enhanced Automatic Voltage Controller in its "elegant" case.*

Alternative circuits: Using the dot mode for voltage display

While the circuit does not draw much power, it is possible to reduce the current to around 12 mA by operating the LM3914 in the dot mode. This will also reduce the power dissipated in the LM3914. If you wish to run the LM3914 in the dot mode, LED #1 will not work as a control point because it has too high a leakage current in the dot mode (this is a basic LM3914 design fact). The circuit is easily modified, as shown in **Fig. 2**. R15 will cause T1 to be on whenever *any* LED is on. When the voltage falls below 11.4 volts all the LEDs turn off and no current flows through R15 (except leakage current). Setting R3 at about 360 ohms (for 4.0 mA of LED current) gives a voltage drop of about 1.4 volt across R14 when any LED is on which turns on T1.

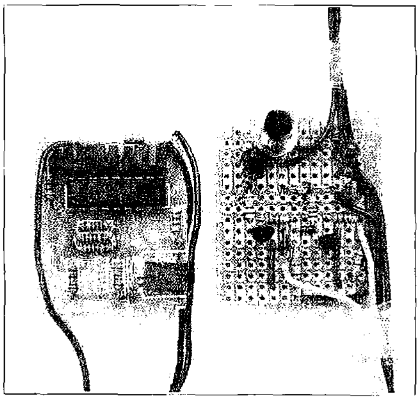


***Photo C.** "Guts" of the Enhanced Automatic Voltage Controller. Note the simple parts layout on the Radio Shack PC board.*

Using a normally open relay

If you want to build this project but don't want to have to locate a high-current NC relay, you might do what I first did, and use the Radio Shack™ NO relay (275-226). To use the NO relay it is necessary to modify the circuit a bit. See **Fig. 3**. Q2 is a MOSFET which is turned on when Q1 is not conducting because its gate is high. This holds the relay closed. When Q1 conducts, Q2 shuts off and the relay opens. You might wonder why Q2 is a MOSFET and not an NPN transistor. Q1 is basically a diode so when it conducts the drop across it is about 0.7 volts. This will not turn off a transistor but will turn off a MOSFET which needs about 2 volts on its gate to conduct. This circuit will draw around 200 mA because the relay coil is energized all the time. The addition of a simple SPST switch between the coil of K1 and V+ will let you de-energize the coil when you are not using the rig. You still get the voltage display from the LM3914 and current draw is only 25 mA.

Parts List	
(All resistors 1.4 watt 5%, unless otherwise noted.)	
R1	7.68k 1%
R2	3.83k 1%
R3	3.2k (1.2k fixed and 2.0k pot)
R4	10.0k 1%
R5	5.0k 1%
R6	24k
R7	15k
R8	100k
R9	15k
R10	1k
R11	24k
R12	15k
R13	10k
R14	33k
R15	360 ohms
C1,C2	1.0 µF
T1	PN2907
T2	PN2907
Q1	2N5061
Q2	IRFD020
D1,D2	1N4148
D3	1N4001
LED#1-11	LEDs
PB1	NC push-button

Obtaining the parts and building the project

I built the AVC part of the circuit in a small Radio Shack box and glued my modified TT-T Tester (still in its original Tic-Tac-box case) to it. It may not look elegant but it was quick and easy to build and it works fine. After all, I wanted to improve the circuit, not the package!

Parts are available at the usual parts suppliers. I still have parts (including a PC board and 1% resistors, for the 11.4 to 15 volt range) and can supply the parts for the rest of the project, except for a PC board. As **Photo C** shows, the rest of the circuit is simple enough that it can be easily made on a Radio Shack universal board (#276-150).

Tiny Tic Tac Tester: All parts, PC board, instructions—$15.

Voltage Values Displayed by LM3914	
LED# Turns On	When Voltage Reaches
LED#1	11.4 volts
LED#2	11.8
LED#3	12.2
LED#4	12.6
LED#5	13.0
LED#6	13.4
LED#7	13.8
LED#8	14.2
LED#9	14.6
LED#10	15.0

All parts for the Enhanced Voltage Controller (includes the Tic Tac Tester parts, plus all parts and instructions for the controller except a PC board; includes a 40 amp NC relay—$25. 73

Number 46 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Still More Stress

For the last few months, we've been discussing electrical, mechanical and thermal stress, examining how each affects various components. Let's continue:

More caps

When we left off, we were looking at capacitors. The problem with caps is that there are so many different kinds, it makes it hard to generalize about them! So, let's look at still a few more types of caps.

Plastic capacitors, typically made of polypropylene or polystyrene, are used where low drift and accurate capacitance are required. Many plastic caps come in small, green, dipped packages and are somewhat rectangular, often with rounded corners. Inside the hard-dipped shell is a foil and plastic arrangement that's wound in layers, at least in the larger values. The stability of plastic caps comes from the inherent stability of the plastic itself, which changes its dimensions and density very little with temperature.

Plastic caps are very rugged. You won't break them if you drop the rig. (Of course, if you sit on it, that's another story.) Their voltage ratings vary from around 50 volts to considerably higher voltages. As with any cap, you can blow holes in the insulating layer with too much voltage.

No plastic cap should get hot in normal operation. I've never seen a leaky one but, of course, it could happen. As with any leaky cap, the resulting current flow would heat up the part.

External heat doesn't seem to be much of a problem with these caps, either. The plastic insulating layer inside could melt if things got *really* blistering, but that would be an extreme circumstance. I have seen a couple of open plastic caps near big heat sinks, but not for many years. I suspect their reliability has increased over the last 10 or 15 years.

Variable caps

Most variable caps use either air or plastic for their insulating layers. Air caps are nothing more than plates with space between them! They are fairly rugged, but the plates can be bent pretty easily, making them subject to mechanical stress. If the plates get too close to each other, the cap will be more susceptible to overvoltage arcing. And, of course, if the plates actually touch those from the opposite side of the circuit, the cap will become a conductor, and cease being a capacitor at all!

Plastic variables are less prone to plate bending because the plates are pushed up against the plastic, rather than hanging free in space. They are pretty hard to break, unless you turn one so hard you tear the plastic. It's not easy to do.

While receiver circuits use such low voltages that they don't stress variable caps, the voltage ratings of the parts must be carefully observed when the caps are used in transmitters. A high SWR, or a transmitter pushed to produce more power than it was built for, can raise the RF voltage high enough to punch through plastic caps, or to arc over air caps. Plastic caps will be ruined if the plastic has holes zapped through it, but air caps may survive. An arced air cap, though, will have burn marks on it, and those areas will not work as well as the normal metal, resulting in a less-efficient cap. Also, a hot enough arc may actually melt the metal plates, destroying the capacitor. I've seen plenty of arced air variables in antenna tuners, though, and that still seemed to work fine.

Important note: The voltage ratings for caps are normally stated in volts DC. At radio frequencies, the number must be derated (made smaller) by a factor that depends on the frequency of operation—so don't assume a 100-volt capacitor will withstand 100 volts of RF at 146 MHz! At such a high frequency, the part may break down with perhaps only 30 volts across it. Cap manufacturers usually offer derating charts that show permissible voltages at various frequencies.

> **"If things get hot enough to melt metal plates you have more to worry about than capacitors!"**

Like all caps, variables shouldn't get hot. Plastic ones can be leaky, but it's rare, especially since they pretty much never have serious power applied to them. Air variables only leak if they become very grimy or oily, opening a new path from one side to the other. Of course, if you arc an air variable, it isn't going to stay cool!

External heating can kill a plastic variable, but generally not an air variable. If things get hot enough to melt metal plates, you have more to worry about than capacitors!

Inductors

Coils and transformers are subject to stress, too. Many are tightly wound and have shellac or something like it coated on the wire for insulation, rather than the plastic jacket used on normal hookup wire. It's often important for the insulation to be thin because the tight windings provide maximum magnetic energy transfer, thus maximum efficiency—but that thin insulation can break down from excess voltage.

Essentially, the adjacent windings act like capacitors because the two wires can, at any given moment, be at different voltages as the energy moves back and forth within the coil. Two conductors at different voltages, separated by an insulator (here, the wires' insulation) equal a capacitor, right? So, the rules for caps apply here, as well as others relating to wire itself (like melting!).

Typically, coils and transformers break down in two ways. Adjacent windings short to each other, especially in high-voltage transformers, such as the "fly back" transformers in TV sets and computer monitors. Or, windings melt, causing an open circuit. That, of course, is caused by excessive current heating the wire enough to melt it. It happens more often than you might imagine. In fact, it's probably the primary cause of transformer failure.

Although external heating is unlikely to kill inductors, internal heating is their nemesis. Like resistors, though, most inductor failures are caused by some other circuit's pulling too much current through the wire. And, oddly, the damage may be on the other side of the magnetic circuit! Many power transformer primaries open after something shorts out the output of the secondaries! The secondaries themselves are often unharmed.

Switches and relays

Contacts have several failure modes. Overvoltage can cause them to arc, just as in the plates of an air variable capacitor, which is essentially what a switch is when it's off. As you turn it on, the contacts get closer and closer together, until the voltage can break through the air between them and arc over.

Overcurrent can actually weld contacts together! I used to have a linear amplifier whose power switch did that all the time. The inrush current to the power transformer was so huge that, if the switch contacts happened to touch right around the moment the AC power input's wave was at maximum, the switch would weld itself in the "on" position, requiring me to pull the switch out and break the contacts apart with a screwdriver (after unplugging the amp, of course)! It used to happen only about once in 20 times, but it was a pain in the neck.

Relay contacts are just switch contacts, so they suffer the same problems. Contacts should never get hot. If they do, check them for blackening or loss of plating. As long as the resistance is nice and low, significant heat is not going to happen.

Many people file contacts, but it is a cure somewhat worse than the disease. It will work for a little while, but the loss of the plating which occurs with filing usually leaves pure copper, and copper makes soft, easily damaged switch contacts—that's why they plate the darned things in the first place. Filed contacts usually go bad again in very short order.

Connectors

There are so many kinds that it's hard to classify them. Normally, connectors are hardy, unless you arc them over with way too much voltage. Some insulating materials used in RF connectors, though, can heat up if lots of power is applied, especially at very high frequencies. After all, a connector is a capacitor, too, what with its having two conductors separated by an insulator. It really pays to observe power and frequency limits for the various kinds of connectors, and to always use connectors appropriate for the purpose.

Well, I think we've covered the stress issue pretty well. Next time, something different! Until then, 73 from KB1UM.

Number 47 on your Feedback card

Hams with Class

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

The Keys To Success

As a follow-up to previous columns which described various telegraph keys that my ham radio classes have had fun making, I'll describe one that many students used for this year's Science Fair at our school. Most of the materials are easy to obtain so we didn't run into that as a problem.

"All the kids had a chance to participate in contributing something to the display."

Construction

For this key you will need: 10 feet of insulated wire (commonly called bell wire), a dry cell, a three-inch by four-inch piece of aluminum foil, three brass paper fasteners, a large nail, a paper clip, and a milk carton.

First, cut away the top of the carton. Then cut a piece one inch wide by three inches long from the center of one side of the carton. Next, cut the opposite side.

Cut a six-inch piece of wire (to be used later). Then wrap the remainder of the wire around the nail to make an electromagnet. Leave six-inch ends to the wire. Remove the last inch of insulation from each end, and also from the ends of the six-inch piece. Wrap the aluminum foil around the strip you cut from the side of the carton. Then fasten it at the top of the milk carton, using a brass paper fastener. At the same time attach one end of the wire from the electromagnet to the fastener. At this time also attach the short piece of wire to its fastener.

Now slip the dry cell inside the milk carton. Attach the other end of the short wire to one pole of the dry cell, and the wire from the electromagnet to the other pole.

Attach the paper clip and a brass fastener to the cut strips at the side. Stick a small piece of cellophane tape over the paper clip. Put the electromagnet in place with the end about one-quarter inch above the paper clip.

Displaying the keys

Now the kids in your class will be ready to put all the telegraph keys on display or to put their own telegraph company into business. Sometimes there's a problem getting the milk-carton telegraph key to click. If you don't get a click, move the electromagnet down a tiny bit at a time until you do.

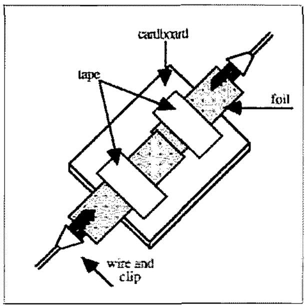


Fig. 1. The milk-carton telegraph key.

For this display of telegraph keys that one of my classes was working on, the kids came up with a great idea. They not only showed all the different types of homemade telegraph keys that were fun to make, but they did some research, built older models, and included photographs of some classics.

In a future column I'll show photos of the actual displays the children organized. It was a wonderful project and it gave all the kids a chance to participate in contributing something to the display.


Photo A. Alicia Kube (left) and Diana Dasalla, 7th grade ham radio students, doing a presentation on telegraph keys and batteries.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

As has been my custom these past 20 years of "RTTY Loop," let me be among the first to wish each and every one of you a Happy New Year! May this year be one of health, success, and peace for us all.

We have been discussing, of late, all of the latest computer programs available for radio teletype, packet, and other digital forms of communication. One question often asked is where these programs may be found. This month, here's a look at two massive online sources.

CompuServe

The granddaddy of online services, CompuServe, has recently revamped its interface and, with CompuServe 3.0.1 as an access program, the service has a new face, if not new content. The amateur radio segment of CompuServe can be reached by the GO HAMNET command. **Fig. 1** shows the opening screen of this venerable resource.

Fig. 2 shows the variety of topics covered in the message section, ranging from scanners to packet to company-specific information. Within each section are a few to dozens of messages dealing with a wide range of information. This is a good place to post that question or puzzle that interests you. It is likely the answer will be there the next time you check in.

A similar range of topics is covered by the file libraries, shown in **Fig. 3**. With 23 sections of information and hundreds of files available, this is often the first place to find the latest release or update of ham radio software.

Over the years, I have always found a wide variety of material on the CompuServe system, with a breadth that is hard to beat. You don't need the latest access program to use the service—the content is the same no matter which door you come in.

> ***"Recently-introduced economy and flat rate pricing structures have made using CIS and AOL much more attractive."***

America Online

Although quite a bit younger, America Online has made quite a name for itself, and has quite a nice amateur radio section, as well. **Fig. 4** shows the entrance screen for their Ham Radio Club, reached with the keyword Ham Radio. There are quite a few features, as can be seen, although the ARRL section is a tad dated, with information many months old online.

Just as with CompuServe, a message section is available, as shown in **Fig. 5**, with a variety of topics and room for thousands of messages. Unlike CompuServe, where messages scroll off the system after a while, AOL seems to hold them online for much longer, making searches of topics and threads a bit easier.

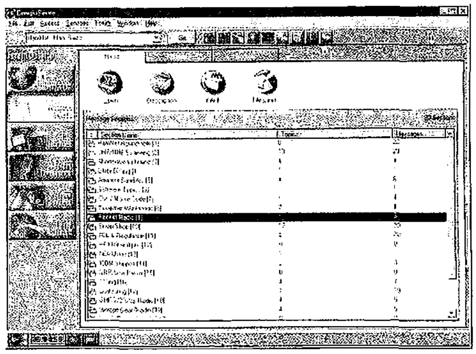


Fig. 2.

Their *Software Exchange*, shown in **Fig. 6**, supports file libraries for a variety of systems. Even the Macintosh, which seems poorly represented on some systems, has a section; **Fig. 7** shows what is currently available. There is also a live conference area, which sponsors online chats, giant cyberworld QSOs, on various ham radio topics.

Although these online services were once quite expensive, recently introduced economy and flat rate pricing structures have made using CIS and AOL much more attractive. If you are on one of these services, why not take a look at the ham radio boards, if you have not already. For some users, these represent an attractive alternate to other types of online providers.

An example

While online, I received a message on CompuServe from S. Neil Xenias N4CTB, who posed the following question: "I have recently purchased a Dovetron Terminal Unit, and I'm wondering if it is worth adding to the digital portion of my ham station. It appears to be operational, and I noticed the digital (RS-232) output port on the rear panel, thinking perhaps it might work with a computer-based station. I have contacted Dovetron for advice, and was hung up on (twice) when I mentioned requesting technical assistance. So with hurt feelings, I thought of asking you for advice. Should I keep this thing or cannibalize it?? Thanks in advance, Doctor, and my best 73!!"

Well, Neil, the Dovetron terminal units have been quite popular for many years, and I would be surprised if it would not do you well. I understand the need for documentation, though, even if the folks at Dovetron do not. So, I turn to the readership of this column. Anybody? If so, drop me a note, or direct the information to Neil directly. I know you won't let me down.

Of course, when it comes to online sources, you can't go wrong surfing on over via the Internet to the RTTY Loop Home Page. I have been doing some upgrades and am trying to put some of the programs you have

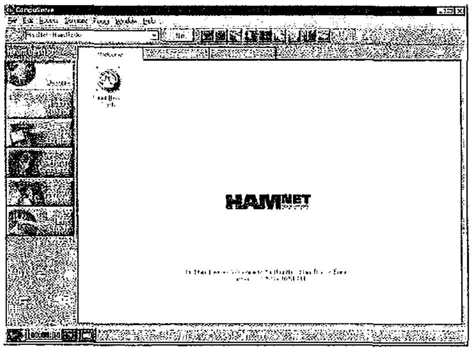


Fig. 1.

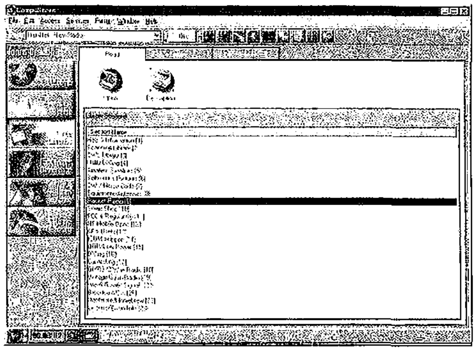


Fig. 3.

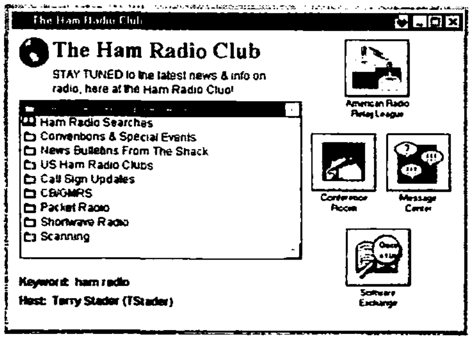


Fig. 4.

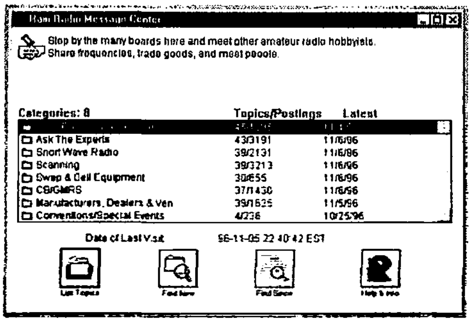


Fig. 5.

asked about up for downloading, as well as links to many ham radio sites on the World Wide Web, and there are many, many ham sites! Stop by the page at http://www 2.ari.net/ajr/rtty/ and see if you can't find something interesting. If you have, or know of, an amateur radio related site, drop me a line and let me know, so that we can establish a crosslink. Speaking of links and webs, I plan some antenna work this fall and winter, when the trees are bereft of their foliage. Stay tuned—those of you who remember my exploits with a bow and arrow a few years back won't want to miss this one!

So, let me hear from you, via mail, or via E-mail at ajr @ari.net, or Marc WA3AJR on AOL, or 75036,2501 on Compu- Serve. You are all part of this column, and I do love hearing from each of you. ■

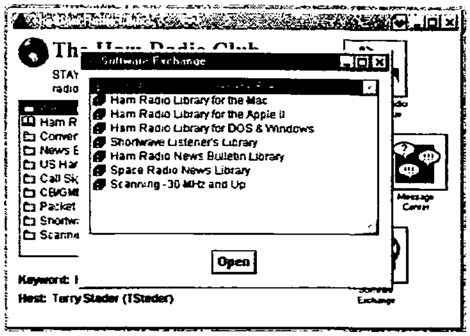


Fig. 6

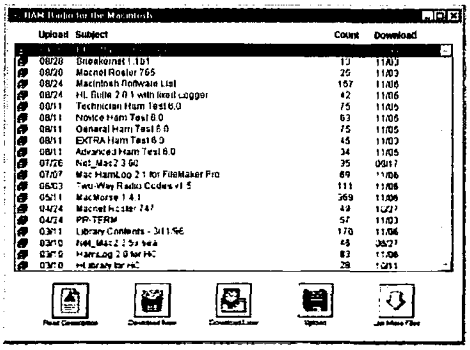


Fig. 7.

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Some Potpourri: Wanna Make History?

Wanna help make history and do some VHF hamming in the bargain? Or how about honoring history, making some history and doing some neat hamming? All are possible, although it's going to be pretty hard. The Irish Radio Transmitters Society (IRTS) announced a contest last year for the first transatlantic ham communication on 2 meters.

The winners will each receive one of two crystal glass trophies generously provided by the Waterford Crystal Company, whose products are known worldwide. In fact, if you've bought any of that stuff you'll know that a custom piece of Waterford is a fine and expensive prize indeed! Waterford Crystal, after all, is one of the finest producers of crystal glassware in the world (and an Irish icon).

"The winners will each receive one of two crystal glass trophies generously provided by the Waterford Crystal Company."

The crystal trophies are called the Brendan Trophies, after the legendary Irish folk hero, Saint Brendan. Among the Irish, he is probably second only to Saint Patrick, and is often referred to as "Brendan the Bold." And why was Saint Brendan so bold? Well, if his travels, chronicled in *Navigatio Brendani* (*The Voyages of Brendan*), are actually history instead of folk tales and storytelling, then he may well have sailed to the east coast of North America—transatlantic—in the end of the fifth, or beginning of the sixth, century A.D. ... in a leather boat! There is about as much time between Brendan and Leif Ericson, who also apparently made the journey, as there is between the first English settlements in North America and Wayne Green's birthday. In other words, ol' Brendan was a pretty early traveler to North America, if the stories are true.

Internal evidence of the legend suggests that he probably reached Iceland or Greenland, and possibly Nova Scotia, nearly half a millennium before Leif Ericson. The stories date to that time, and have verifiable facts, or at least suggestions of facts. That Brendan's feat is at least possible was proved in 1976 by Tim Severin, who repeated the journey in a leather boat of traditional design. If you are one to bend an elbow in honor of the bold (or the foolish), then St. Brendan's feast day is May 16th each year.

For radio signals, the North Atlantic path has always been something of a challenge because it crosses magnetic lines of force at high latitudes, and is bombarded with assorted troubles such as the aurora, particles and radiation from space. Indeed, "something of a challenge" often means downright difficult.

The short-term radio propagation condition predictions are usually made for the North Atlantic path because it describes nearly-worst-case conditions. An ionosonde device tests the path between the continents, and that data is published on radio stations such as WWV.

Marconi was the first to cross the Atlantic on a radio "boat" ... about a millennium and a half after Brendan and a millennium after Leif (by the way, I know a Norwegian lady who celebrates October 12th not as Columbus Day, but as Leif Ericson Day). Marconi probably used LF frequencies, which were more practical than the shortwaves in those days, to transmit the Morse code letter "S" from the west coast of England to a receiving site near St. Johns, Newfoundland, in December 1903.

It took another 20 years for the shortwave radio to cross the Atlantic. On the night of 27 November, 1923, the contact was established by ham radio operators ... and it startled the world! Today, anyone with a few watts loaded into a wet string antenna can work transatlantic contacts with ease. I recall one old fellow who gave ham club speeches on early radio, having been one of the first post-war, i.e. post-World War I, hams to be licensed. In about 1960, he came to the Potomac Valley Radio Club, of which I was a member, and gave us a talk. (Personal note: Former ARRL President Vic Clark W4KFC picked me up for meetings; because I am an epileptic I could not medically qualify for a driver's license until I was 23.) He told us how they were using frequencies as close to 200 meters wavelength (around 1,500 kHz in the AM BCB to our present-day 160 meter ham band) as possible. The HF frequencies were considered useless (which is what prompted the famous "... 200 meters and down" statement that is enshrined in Clinton B. DeSoto's book of the same title). The antenna was strung out across his father's Piedmont Virginia farm, and was one of those three-wire flat-tops that ran about 600 to 1,000 feet down the meadow. "DX" was any station two states away.

In 1924, he went away to the University of Virginia to study engineering, and left the ham station to his younger brother. When he returned for Thanksgiving, he noted that the flat-top antenna was gone, and was replaced with a couple of puny little things between 60 and 120 feet long. His brother sheepishly told him "we are using the shortwaves now." Skeptical, the fellow decided to send a message to his roommate, who lived in Ohio. So, hearing a station with an "8xx" callsign (they didn't use national designators in those days, so one-by-two callsigns such as "1AW"—Hiram Percy Maxim's callsign before it became "W1AW"—were used) he asked the guy to relay the message to Canton, OH. "Sure, OM, I'll be glad to, but you are probably in a better position to relay it yourself than me because I am FRENCH 8xx." He darn near fell off his chair! His first DX was over the supposedly intractable Atlantic Ocean, with little more than 15 watts of power.

Now, back to the Brendan Award. Some people claim that the 2 meter Transatlantic Challenge sponsored by IRTS will be a greater technical achievement than Marconi's 1903 work ... so here's your chance for immortality. The award will go to the first two amateur radio stations who establish two-way contact on 2 meters, across the Atlantic ocean, without using a satellite or earth-moon-earth (EME) methods. That would be cheating!

Both stations must be physically located on land, or on non-tidal waterways, within the boundaries established by the continental shelves of Europe and North America. Each operator must be properly licensed as an amateur radio operator by his or her national government, and be operating within the provisions of that license (especially power and frequency limits). IRTS reserves the right to have its representatives inspect both claimants' stations to ensure that things are on the up-and-up.

The normal rules for an established ham QSO apply to the 2 meter Transatlantic Challenge. Both stations must receive the callsign of the other in full; signal reports must be exchanged (any recognized system—RS, RST, meteor scatter—can be used, but it must include at least two characters); each station must receive confirmation (Morse "QSL," "R" or voice "Roger") from the other. The data must be exchanged within a single four-hour period. If the four-hour period expires, then a new contact-pair (another four-hour period) must be established.

In something of a "shades of Marconi" effort, the Radio Society of Great Britain (Lambda House, Cranborne Road, Potters Bar, Herts., EN6 3JE, England) is setting up a special account for donations to its RSGB Propagation Studies Committee to allow the establishment of permanent beacons

on 2 meters. One beacon will be located near Lands End, England, and the other near St. Johns, Newfoundland. That project could result in some substantial propagation studies, and could lead to the information that will cause someone—or more than one someone—to win the St. Brendan Trophy.

For a good source of technical information on the problems of 2 meter transatlantic propagation, check out "How To Win The Brendan Trophies" by Dr. Geoffrey H. Grayer in the June 1995 issue of *Radio Communications* (*RadCom* is the journal of the RSGB, and thus enjoys a position similar to the ARRL's *QST* among British ham operators). The address for RadCom is the same as for the RSGB above).

"Here's your chance for immortality."

The Brendan challenge is not impossible, but it would be very difficult. One of my earliest ham writing tasks was the monthly report of the Northern Virginia Radio Club (club station W4PAY) to the Foundation for Amateur Radio's *Autocall* newsletter. As a result of that task, I received an invitation to the 1960 Edison Award (sponsored by General Electric) banquet in Washington, DC. The two fellows who won the award that year had established two-way ham contact on 2 meters between California and Hawaii. Not exactly the North Atlantic path, but about as far (although I would prefer being in KH6-land than in any location in the North Atlantic ... save only El-land and G/GM-land, for which I have a special fondness).

"Hams With Class"

One of my favorite ham columns has been "Hams With Class" in *73*, partially because I have a soft spot for people who work with kids and introduce them to radio in general and ham radio in particular. Every year I judge several science fairs, and am impressed with the ability of kids to do science and technology. A lot of them are little more than re-doing classroom demonstrations, or worse, but another big bunch is doing some real science (unfortunately, I won't be able to judge too many science fairs this year because I am teaching a Northern Virginia Community College class in Visual BASIC on Saturday mornings).

The point of this digression is that we hams have an opportunity to hook kids into the hobby at an early age through education. There are a couple of ways to go about this (besides reading "Hams With Class"). First, you can mentor (or is that "Elmer"?) youngsters who show interest in radio. That's how I got started (Mac Parker W4II was mine), and I suspect it's how many of you-all got started as well). Another way is to work with high school and junior high school science fairs, or volunteer to work with the science departments.

In some schools, they permit college-degreed members of the community to teach science classes, although under the supervision of a licensed teacher. That's a possibility for both community involvement and (in some cases) a little (very little, sadly) extra income. In other cases, even non-degreed people with industrial arts experience are allowed to teach shop classes (again, under a licensed teacher's supervision). An auto mechanic I know teaches a two-hour shop class every day at the local voc-tech school (a high school with an industrial arts flavor).

You can also set up demonstrations of ham radio for the school, or serve as a community advisor or mentor to a student ham radio club (I've seen both done).

Still another tactic would be to become familiar with radioscience observing, and integrate ham radio into it. This activity includes looking for natural radio signals such as whistlers (1 to 10 kHz), sudden ionospheric disturbances (SIDs) caused by solar flares (these are found by monitoring 15 to 30 kHz VLF stations for sudden increases in signal level), and propagation studies (especially during solar eclipses or other solar events). Ham radio can be "snuck into" such activities.

Still another way is to find and encourage schoolteachers who want to get into ham radio themselves. Mentor them, get them licensed, and help them set up a station. You do that with newbies anyway, so why not concentrate some advertising for your club's Novice class on the local schools? I recall a seminary professor who taught at a school that had a large contingent of Third World students on scholarship. He said the reason was that it cost $25,000 a year to keep a missionary in those countries, but only $10,000 a year to educate a national ... who would go back home and remain in place teaching for many, many decades (at no additional cost or effort). The same principle applies for hams: Teach a teacher how to "fish" and you won't have to feed his or her students yourself. Teachers, after all, are largely dedicated to their profession, and will perform admirably to mentor young hams-wannabees and help them get licensed. Putting a little effort into junior and senior high schools, not to mention the upper end of the elementary grades, will pay rich dividends for the hobby.

How important is getting more lifetime hams into the hobby? Radio spectrum is precious, and there is a simple rule in effect: Use it or lose it. Remember, the 11 meter Citizen's Band was a ham band pre-1957. We lost it to the Class D CB service because the FCC could see that very few people were using it ... the 1956 or 1957 "Save 11" contest at the last minute notwithstanding.

Connections ...

I can be reached via snail mail at P.O. Box 1099, Falls Church, VA 22041, or via Internet E-mail at carrjj@aol.com.

HAMSATS

Number 52 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

Good News—Bad News

We start the new year without AMSAT-OSCAR-13. This high-orbit, long-life satellite was launched in June 1988. Since then it provided hamsat enthusiasts quality high-tech communications for over eight years before succumbing to the gravitational effects of bodies beyond the earth. Most satellites in elliptical orbits with a perigee, or low point, of thousands of miles will stay in orbit for hundreds, if not thousands, of years. Due to the orientation of A-O-13's orbit, this was not the case. The forces of nature took over and its premature end was inevitable as its perigee was pulled closer to the earth by the sun and moon.

On the positive side, A-O-13 performed extremely well while in orbit. AMSAT-OSCAR-10, while not as functional as A-O-13 was before reentry, still provides high-orbit, Mode "B" (70 cm uplink and 2 meter downlink) operation almost 13 years after launch. Before launch, A-O-10 was known as Phase 3-B. It was the second Phase 3 hamsat. Its predecessor, Phase 3-A, never made it into orbit due to a rocket malfunction in early 1980. Excellent long-distance contacts are still possible through A-O-10 when conditions are right. The on-board computer no longer works, but the Mode "B" radios and the solar cells are doing well. When the satellite is properly illuminated, signals are good.

Phase 3-D coming soon

Amateur radio's next major satellite is scheduled for launch in April 1997. Named "Phase 3-D," this satellite is the largest, most complex and most expensive ham-radio satellite ever built. Volunteers in over a dozen countries on five continents have been working for years to bring this project to fruition.

The launch is to be the second ever for the new Ariane 5 rocket. The first Ariane 5 failed in June 1996. Corrections have been made, tests have been run, and optimism is high for the second flight. Phase 3-D will be sent up with a pair of technological measurement packages for validation of the launch vehicle's ability to place two satellites into a geostationary transfer orbit.

After launch, Phase 3-D will become an OSCAR (Orbiting Satellite Carrying Amateur Radio) and will begin a period of testing and orbital adjustment that may last months.

In the meantime...

Waiting for the new high-orbit satellite needn't be dull. We have over a dozen operational LEO (low earth orbit) hamsats in orbit available for use four to six times a day each, anywhere on earth. Frequencies used on these satellites range all the way from the 21 MHz uplink of RS-12 to the 2400 MHz downlink beacon of Dove-OSCAR-17. There is a good mix of digital and analog (voice/CW) satellites available. We have new satellites like Fuji-OSCAR-29, launched only a few months ago, to older satellites including UoSAT-OSCAR-11 launched in March 1984.

The South Africa AMSAT Award

In a cooperative effort with Southern Africa AMSAT, the Radio Amateur Satellite Corporation (AMSAT-North America) is promoting the South Africa AMSAT Satellite Communication Achievement Award. This award is the perfect entry-level award for satellite enthusiasts. The requirements are simple. Send 25 QSLs (or good front and back photocopies) for Phase-2 (low earth orbit) satellite contacts to the AMSAT Awards Manager. The fee is $3.50 for AMSAT members and $5.00 for non-members. Additional funds are requested for the return of QSL cards if photocopies are not submitted. Send to: AMSAT Awards Manager, Mike Scarcella WA5TWT, 310 Lombardy, Sugar Land, TX 77478. Mike has been authorized to issue the South African award without the long delays previously encountered with overseas submission. The low-orbit hamsats can be a lot of fun.

A New Year's event

For many years the ARRL has sponsored Straight Key Night (SKN) on New Year's Day. Ray Soifer W2RS invites interested satellite operators to participate in the 25th annual SKN via OSCAR. He reports that there are no rules, no scoring, and no need to send in a log. Just call CQ SKN in the CW passband segment of an OSCAR between 0000 and 2359 UTC on January 1, 1997, or answer a CQ SKN call from another station. Contacts via the moon also count. Ray refers to the moon as OSCAR-0. Nominations for the best "fist" can be sent via the Internet to w2rs@amsat.org.

An end before a beginning?

Less than a month after the successful launch of Fuji-OSCAR-29, Mexico-OSCAR-30 (M-O-30) was successfully placed in orbit from the Russian Plesetsk facility on September 5, 1996. The satellite's polar orbit is just under 1,000 kilometers (600 miles) high. Signals from the satellite were received shortly after launch, but there is a problem. The signals disappeared after several days and attempts to command the satellite failed. Work continues in an attempt to bring M-O-30 back to life, but catastrophic failure in the command receiver is feared.

Prior to launch, the new satellite was called UNAMSAT-B. This was not the first UNAMSAT, but rather the replacement for UNAMSAT-1 which never achieved orbit. The UNAMSAT-1 launch attempt on a converted Soviet SS-25 (TOPOL) missile met a fiery end when an upper-stage motor failed on March 28, 1995. Following the disaster, the UNAMSAT crew was dejected but not without hope. Two sets of spacecraft modules were originally built.

While UNAMSAT-1 lay in a mass of rocket debris somewhere in eastern Russia or on the bottom of the Sea of Okhotsk, the back-up modules were waiting safely back in the lab in Mexico City. It took a lot of work over a one-year period to get the second UNAMSAT ready—to buy new solar panels and get another ticket to orbit. Project Director David Liberman XE1TU provided the needed drive. UNAMSAT-B represents the never-say-die attitude of true space pioneers.

UNAMSAT-B

Built at the Universidad Nacional Autonoma de Mexico by the PUIDE (Programa Universitario de Investigacion y Desarrollo Espacial, or University Program of Space Research and Development) group, UNAMSAT-B is the most recent

Uplinks	Channel A	145.815 MHz - 1200 baud AX.25 FSK
	Channel B	145.835 MHz - 1200 baud AX.25 FSK
	Channel C	145.855 MHz - 1200 baud AX.25 FSK
	Channel D	145.875 MHz - 1200 baud AX.25 FSK
Downlinks	UHF TX1	437.206 MHz - 1200 baud AX.25 BPSK
	UHF TX2	437.138 MHz - 1200 baud AX.25 BPSK

Table 1. Band plan for Mexico-OSCAR-30.

microsat "clone." The first microsats were launched six years ago from French Guiana. They are small cubes, 25 cm on a side, weighing about 10 kg each, with five internal stacked modules. Four of the modules contain standard systems common to all AMSAT microsats; a five-channel 2 meter receiver, battery charge regulator unit, computer and 70 cm transmitter. The fifth module in the stack is called the TSFR, or "This Space For Rent." The TSFR in M-O-30 contains an intriguing experiment to identify meteors that have velocities greater than 72 km/sec.

The five-channel, 2 meter receiver was designed for digital (1200 baud FSK AX.25) uplinks from users on four simultaneous channels: 145.815, 145.835, 145.855 and 145.875 MHz. The fifth channel is the unpublished uplink for ground-based control stations. It is used to send software up to the satellite and change onboard operational parameters. A failure in the command receiver is one of the possible reasons for M-O-30's silence.

The BCR module, or battery charge regulator, contains not only the power control circuitry, but also the nickel-cadmium batteries that allow the satellite to operate during eclipse periods.

The computer module uses a radiation-hardened NEC V40 microprocessor. There is also a 256 Kbyte bank of EDAC memory and an additional 4 Mbyte bank of SRAM. Total computer-system power consumption is under 1 watt.

The transmitter module contains two separate UHF transmitters for telemetry and communications downlink. Both use BPSK (bi-phase shift keying) modulation at 1200 baud, AX.25 protocol. The primary transmitter is on 437.206 MHz, and the secondary transmitter is set to 437.138 MHz. Only one transmitter at a time is activated, but either can be used for all telemetry and data communication purposes.

The body of the satellite is surrounded by high-efficiency gallium-arsenide solar cells and a thin quartz crystal coating. The 2 meter antenna is on the top, while the 70 cm antennas are arranged around the bottom. The 41 MHz antenna is a canted dipole.

The TSFR module

Packed into the fifth module is a 70 watt (RMS) radar transmitter on 40.997 MHz, a sensitive receiver and a computer. The transmitter sends short pulses (1 to 16 ms) every one to 16 seconds. The 41 MHz transmitter is licensed by Mexico according to the ITU (International Telecommunications Union) frequency allocation listings. The receiver then listens for echoes from ionization trails caused by meteors as they burn up in the atmosphere. The returning echoes are digitized, analyzed by the computer and then downlinked as data files on 70 cm for study.

In order to provide the temporary but high current needs of the radar transmitter, special buffering on the 10 volt satellite power bus was required. A special switching power supply was designed to charge a bank of 16 tantalum capacitors to 40 volts between pulse transmissions. The system does not overload the main power bus and has a DC-to-RF efficiency of 92 percent.

The 41 MHz receiver is a single-conversion design with both lower and upper sideband detectors. Total bandwidth is about 20 kHz, enough to handle the maximum Doppler shift expected from returning meteor-trail echoes.

For meteors, 72 km/sec is the solar system escape velocity. Meteors traveling faster are from outside our system. The TSFR computer (68HC805 microcontroller) records the received echo from the receiver and then sends it to the main satellite computer module as a 64 byte block for further analysis and subsequent transmission via the downlink transmitter. The analysis includes a Digital Fast Fourier Transform (DFFT) and a special buffer system to check for Doppler shift between subsequent received signals. If Doppler shift is detected between the samples (indicating relative meteor speed), the radar transmitter will be set for a faster pulse repetition rate for a period of time. Data that represents meteors traveling above the 72 km/sec speed limit will be logged and stored in files.

Communications

The frequencies shown in **Table 1** define the Mode "J" communications capabilities of M-O-30. The following data was received by Norbert Notthoff DF5DP a few days after launch on the 70 cm downlink before the satellite went silent:

UNMSAT-1>STATUS:?12S f<-
UNMSAT-1>PUIDE:

AFTER ALL IT STILL MOVES......
Y A PESAR DE TODO SE MUEVE....

UNAMMEXICO.
UNMSAT-1>BCRXMT:%?12
UNMSAT-1>TIME-1:PHT: uptime is 005/10:32:41.
Time is Sat Sep 07 18:17:29 1996

More information

Additional information about the M-O-30 and efforts to bring it back to life can be easily found on the Internet. The best source is from the AMSAT World Wide Web site. The URL (Universal Resource Locator) is: http://www.amsat.org. M-O-30 bulletins and updates, along with orbital elements for tracking programs, can be found and downloaded. The AMSAT site provides a link to the UNAMSAT web pages, or you can address them directly at: http://serpiente.dgsca.unam.mx/unamsat/unameng.htm. M-O-30 held much promise both as a fun satellite and as an exciting experiment. If efforts to bring it back fail, let's hope that the UNAMSAT team will try again.

Ham to Ham

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

With the first issue of the new year comes a nice variety of "Ham To Ham" tips. Many thanks to those who've taken the time to send in their ideas (often several) during 1996, as well as to the names that we're seeing for the first time. I'm always looking for more tips, ideas, suggestions and shortcuts to keep the column going and growing, so please don't hesitate. The address is above.

Adjustable antenna tip

From William Thim Jr. N1QVQ: Bill has been very supportive, with a number of good tips. "I own a portable antenna that covers several VHF/UHF ham bands, but it must be physically adjusted for each different band. After losing the adjustment instructions once, I decided not to let that happen again, so I got the tuning instructions from a friend, then transferred them to the antenna's base using a customizable rubber stamp kit like the ones sold in many office supply stores. A coat of clear lacquer spray over the stamping sealed it. To make sure that I always had a tape measure with the antenna for those critical adjustments, I made a trip to the XYL's favorite sewing supply store and purchased one of those 'cloth-tape yardsticks,' attached it to the antenna using a 'twist-tie,' and now I know I'll have everything needed for adjusting the antenna. You can 'customize' this basic idea to fit your own antenna-element needs, depending upon the particular model of adjustable antenna that you have."

Moderator's note: Good idea, Bill; also, don't forget to "twist-tie" that special Allen wrench or an inexpensive small screwdriver to the package if loosening and tightening set-screws is involved in the adjustment. A small, plastic "zip-lock" bag with a hole punched into one corner can hold these odds and ends. The bag itself can then be secured to the antenna package with a "twist-tie" or short length of cable-lacing twine.

Not written in stone

From David Hyman KBØONF: A way to cut down on paper costs in your ham shack: "I've been able to drastically cut down on the amount of scratch paper that I use by assigning the note-taking task to a scrap piece of 1/4" thick, 8 1/2" x 11" chunk of white Plexiglas™ instead. Smooth white Plexiglas is available from surplus outlets around the country at very reasonable prices ... often sold by the pound (look in your Yellow Pages under 'surplus-retail'). It can be easily cut with a bandsaw, or simply scored with a utility knife, then cracked over the sharp edge of a table—the ragged edge can then be either filed or lightly 'fire-polished' with a propane torch (go easy, it doesn't take much heat).

"The white Plexiglas is then the 'perfect' writing surface for either dry marker pens or the water soluble pens sold in art stores and office supply outlets. I prefer the 'dry markers' myself, one of which is the Expo Markaway 3™. No. 83000, by Sanford. Black is probably the best color and a chisel-shaped tip works nicely for me.

"Cleaning the white Plexiglas surface after use is easy too. A dry erase spray cleaner is sold specifically for this purpose, but I've found that lacquer thinner, poured into a defunct glass window cleaner spray bottle, works just as well and at a fraction of the cost. The lacquer thinner doesn't seem to attack or soften the white Plexiglas that I'm using in any way."

Moderator's note: I've used a similar idea in my own ham shack using a "note jotter," consisting of a washable pen and plastic-coated tablet, made for wall hanging near a kitchen telephone. In this case, a damp cloth will erase everything. Remember those little marker slates with a clear plastic on top, followed by a translucent sheet and ending with a black waxy surface? You simply lifted the two top sheets to erase the whole tablet ... great fun to use as I remember.

Considerable cable considerations

From Phil Salas AD5X: "I'd suggest that you consider using 9913 coax cable, instead of the more popular RG-213, for your VHF/UHF antenna feedlines. 9913 has about a third less loss than RG-213 at a given frequency, and is much easier to 'connectorize' with the standard PL-259 UHF connectors. The inner insulation is easier to strip since it is mostly air! The shield is easier to solder to the PL-259 since the inner dielectric doesn't conduct the heat away as it does in the RG-213 type of cables. Cable X-perts (orders 1-800-828-3340, tech inf. 1-847-520-3003) sells 9913 for 42 cents per foot, which is only about six cents per foot more than RG-213. The disadvantages: You must take extra care to properly waterproof your outside connectors (since any internal water will flow easily through its mostly air-filled innards) but you should carefully waterproof all outside connectors anyway. Also, 9913 is not quite as flexible as RG-213, since the center conductor is a solid copper conductor. A stranded center conductor form of 9913 is available, but it's a bit more expensive ... the choice is strictly up to you.

"For waterproofing those outdoor connections and connectors, I've had very good luck with a product called Plast-Dip™. It's a fast-curing liquid plastic material that's intended primarily for coating tool handles. A can of the thick liquid costs about $7 at Home Depot™ and other hardware and home centers, but it should last you a good long while. I usually put two coats of it on all of my outdoor connections. For wire connections, such as separating a coax shield and center conductor for feeding a dipole antenna, I immobilize the point where the shield and center conductor separate, using hot glue (hot glue guns are great for lots of things). Then I attach solder lugs to the ends of the shield and center conductor—where attachment to the antenna will take place. Finally, I dip the entire end (including the solder lugs) into the Plast-Dip and let it cure. After curing, I use a sharp hobby knife to trim off the excess Plast-Dip insulation that covers the ends of the solder lugs. Neat, easy and very waterproof!"

Moderator's note: Good suggestions, Phil. Waterproofing outdoor coax fittings can't be overstressed; any moisture in even the solid insulation coax is disastrous. The shield of a coax must appear as a solid conductor to RF; that is, each overlapping strand of braid must touch as many of its neighboring strands as possible, seeming to be a solid outer pipe. Water of any sort inside the coax jacket spoils this shielding quality (and you can't tell it by DC resistance checks alone—it must be tested with true RF testing, looking for loss or leakage). Even a small nick in the outdoor cable's jacket must be re-sealed. Phil's suggestions on the best (lowest loss) cable are also well taken. Even if your entire cable run can't be of a low-loss variety,

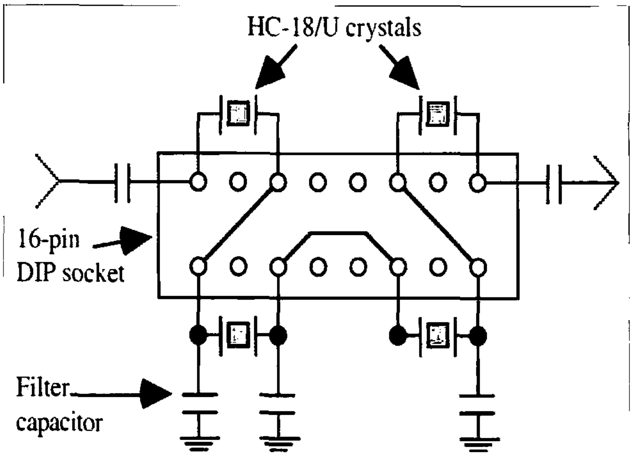


Fig. 1. KB4ZGC/W4LJD'S idea of how a four-crystal ladder filter might be laid out using a standard 16-pin DIP IC socket for mounting the crystals.

every foot that you can manage will be that much better.

Crystal DIP

From J. Frank Brumbaugh KB4ZGC/W4LJD: "When constructing crystal ladder IF filters, you can save PC board space, simplify the layout time and make the crystals much easier to check or replace by simply using a standard 16-pin DIP socket to hold the four crystals needed. Interestingly, the HC-18/U style of crystal with wire leads will plug in directly across three pins of a standard DIP IC socket. A quick look at **Fig. 1** will illustrate how a four-crystal filter would be wired using this scheme. Just clip the HC-18/U's leads to about 1/4", then plug in the crystals after all of the heat-producing soldering has been done. If you need more than four crystals, just add another DIP socket!"

Moderator's note: Clever idea, Frank. By the way, Frank's right, a wire-lead HC-18/U fits perfectly across three pins of a normal DIP socket. I'd recommend using the best DIP sockets you can afford for this application. The ones with round "machined" pins hold the crystal nice and tightly.

Murphy's Corollary: When working out a problem on a specific piece of equipment, try sleeping on it... it's sure to make an impression!

Many thanks to this month's contributors. Without your continued input, I'd soon run out of ideas. Please keep them coming.

William Thim, Jr. N1QVQ
50 Miller Road
Broad Brook CT 06016-9676

David L. Hyman KBØONF
1455 Edgcumbe Road
St. Paul MN 55116

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

J. Frank Brumbaugh KB4ZGC/W4LJD
c/o Defendini
P.O. Box 30
Salinas PR 00751

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73* magazine, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73* magazine for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to *73* magazine's "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73* magazine. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

NEVER SAY DIE

Continued from page 33

in with catcalls, carriers, and jamming, but without signing calls.

If I were an advisor for any company wanting to get the use of a ham band for their products, I'd record and edit a few days of this kind of crapola as proof that there clearly are much better public uses for the billions of dollars worth of ham spectrum we've inherited and are laying to waste. Since we claim to be self-regulating, we have no valid excuse for allowing this kind of sickness to go on.

So why are cesspools like that poisoning our hobby? It seems to me this is largely the result of a lack of credible leadership from our one (and really only) national organization. The pathetic weakness of our ARRL leadership has left amateur radio in a similar situation to a leaderless country like Somalia. This weakness starts right at the top: the ARRL board of directors, which you continue to re-elect. My bumper sticker Never Re-elect Anyone (the NRA for the '90s) should be not just applied to Congress, to help flush out

Continued on page 56

NEVER SAY DIE

Continued from page 55

that mess, but also to your ARRL board of director rubber-stamp voting every other year. Keep flushing until we get some young people in there and see signs of leadership beginning to show.

How will you know? When you see signs that the League is attacking messes like 14,313, K1MAN's endless ego gratification, the lack of youngsters coming into the hobby, our overall lack of growth (except for no-coders), the disinterest of the no-coders in upgrading, and stuff like that.

Amateur radio got grandfathered into most of our present ham bands as a result of the pioneering work hams did in the earliest days of radio. Then we held on to most of our bands by providing clearly visible public services. Amateur radio was often the only means of communicating in emergencies. And, as I keep mentioning, 80% of the licensed hams went into the military for WWII, providing a priceless contribution to our winning the war, in which radio, radar and sonar were critically important.

But today, due to an almost total lack of leadership, we are no longer the pioneering group we once were. We no longer are of any value whatever to the military in case of a war. Even our vaunted emergency communications are disorganized and being made irrelevant as other communications services are passing us by. The only hope I can see for our survival is as a way to help get kids interested in high-tech careers, the way we did before the ARRL virtually stopped youngsters from entering the hobby 33 years ago. We *have* to provide some sort of visible public service if we're going to hold our ham bands, which are worth tens to hundreds of billions today. But without leadership it's only a matter of time, and I doubt that we have much of that.

But how about the FCC—won't they protect us? Why should they? These days we are nothing but a royal pain in the butt and an additional difficult-to-justify expense for an outfit whose budget is being cut back, year after year. Instead of putting the pressure on the ARRL to solve our problems we write to the FCC, demanding help. When nothing comes of that we write to our Senator or Congressman, asking him to put pressure on the FCC to help. And he then sends a copy to the FCC, pushing for action. And since there is little the FCC can do, they just want to stop the pain.

What would you do if you were a politically appointed FCC commissioner? You know little about the history of amateur radio. All you know is that there is a disorganized bunch of old (very old and largely lower middle class) white men who are enjoying billions of dollars worth of the spectrum which they inherited when it was of no value and are these days contributing little in return. All you get is complaints—about interference, bad language, repeater coordination, and so on. Try sitting in a commissioner's chair for a minute and see how that feels.

If you feel that I'm dumping on the ARRL about all this, then please let me know who you recommend to help solve our problems? If you really don't believe our leaders have no responsibility to lead, then what alternative do you suggest? If you don't have an answer, ask your director and then let me know what he proposes.

Or should I start work on a book, *Ham Radio — In Memoriam*?

Professors and Beards

Have you ever noticed how many professors wear beards? Maybe there's a good psychological reason for this. Try on my reasoning and see how it fits.

What has teaching college got going for it? Short hours, lots of prestige, tenure (you can't get fired), paid sabbaticals, and generous retirement benefits. No, you'll never make a lot of money, but the security is a trade-off. And the prestige. They sure play *that* game. Doctor. Professor. Distinguished Professor.

Now, if you were a person with low self-esteem, also known as an inferiority complex, you would tend to look for work where prestige is flaunted. Low self-esteem people can't help but do everything they can to make others think they are important.

But they also tend to want to hide their faces. I went to a costume party when I was a kid. My mother made a Shadow costume for me, complete with a black veil. That was the first time I'd ever been at a party where my face was hidden, and wow, did that feel different. Suddenly I was very outgoing and the life of the party. A veil or mask gives one a sense of security. And so does a beard to hide behind. Think over the bearded people you know and see if you think I'm right.

The only bearded guy I can think of that this doesn't fit was Sam Harris W8UKS/W1FZJ/W1BU, but then he wore his in the '40s and '50s, back when that was an outrageous thing to do—which was why he did it. He didn't just wear it, he flaunted it.

Vegetizing

Unless you've chosen to be uneducated in the food department (aka ignorant), you know that you really should be including a hefty bunch of veggies to your diet. At least if you want to make it with any grace through your 50s and not join the strictly steak and potatoes group in their $2,000-a-day hospital wards. Yes, I know, you and Bush are not broccoli fans. I happen to like it, but I can almost empathize with those who don't. When I was a kid I hated cauliflower and didn't think I'd ever like it. Now I love it.

Anyway, I've found a great way to not just make these veggies delicious, but to do it in their healthiest (for you) form: raw. Here's the deal. I hope you have a blender. I throw in a cup each of raw broccoli and cauliflower, and a half cup of raw carrots. Zizz 'em together until they're in pieces slightly smaller than Grape Nuts.

You're going to need some salad dressing for this. I'm using a couple of tablespoons of my old coleslaw recipe. It has two parts extra virgin olive oil, two parts apple cider vinegar, one part honey, one part mayonnaise, six parts plain yogurt, a teaspoon or two of celery seeds, salt and pepper to taste. Then whip it all together. This makes a fabulous sweet-sour dressing that's great for slaw and as a veggie dip. It's reasonably low cal and easy to

Continued on page 59

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92637

A Foxhunting Jamboree

When did you first hear about radio direction finding (RDF)? Since it has become a tool for finding downed aircraft and stolen cars, today's school kids probably get a vague notion of it early on. Sadly, they aren't told that it can also be great fun for them.

A recent E-mail exchange with Tom Stewart K3TS brought back memories of my introduction to RDF. Tom wrote a classic article about 2 meter hidden transmitter hunting in New Jersey for the September 1957 issue of *QST*. I was 10 years old at the time and studying for my ham ticket, faithfully trying to copy W1AW code practice every night on my drifty Hallicrafters S-38D receiver. That *QST* issue was one of my first ham radio magazines. Tom's tales of T-hunt trickery got me eager to try the sport.

When my Novice license arrived the following spring, I agitated at the radio club in our town of 11,000 souls to get the group to hold some hidden transmitter hunts. Even though Novices had 2 meter phone privileges at the time, we were a hundred miles from the nearest 2 meter activity and there were no repeaters to bridge the gap.

Finally, the club scheduled a hunt on 75 meter AM, where most mobile operating was done in those days. I somehow managed to lash together a two-tube 75 meter converter with vibrator power supply and connect it to the broadcast receiver in the family's gas-guzzler convertible. Of course I had to talk Dad into driving. Bemused by the whole thing, he agreed.

For an RDF antenna, I used the multi-turn flat loop from the back cover of an old table model broadcast set. I hadn't learned enough RF theory to do a good job of resonating and coupling it, so it wasn't very sensitive or directional. Dad and I did a lot of riding around just trying to hear a signal over the ignition noise. Fortunately, the hunt boundaries were small and gas was cheap.

Hundreds of T-hunts later, I still think it is the most fun you can have in ham radio. I wish every youngster could experience it. But how many kids nowadays have supportive radio clubs and patient fathers to Elmer them into it? How can we bring kids and RDF together? I think "Homing In" readers Greg and Gabriella Owens (WA6HKM and KE6JQS) have found an answer.

This campground welcomes foxes

Greg and Gabriella's letter arrived shortly after Labor Day. They were in charge of a committee from the Simi Settlers Radio Club that would be hosting a Scout Jamboree-on-the-Air (JOTA) campout. They wanted to know how to put on a demonstration of foxhunting (also called radio-orienteering and ARDF) as part of their JOTA activities. What an opportunity!

JOTA is a worldwide ham event, held annually in mid-October for almost 40 years. Having never been in Scouts, I knew very little about it. I had no idea if foxhunting had ever been done there before. (Actually, I'm still not sure.) Either way, I knew that this opportunity couldn't be passed up, so I called them immediately.

JOTA celebrations run for a 48-hour period beginning Friday afternoon. They range from simple to elaborate. In some towns, a ham invites a troop or two for a ham shack visit, letting Scouts participate in contacts with other JOTA groups. In other places, it's a full-blown Camporee with many stations and activities. That's what the Settlers were planning.

"We hope to have stations on every active HF and VHF band," Gabriella told me. "We'll demonstrate both voice and CW modes on the air. Local ATVers will set up two stations so the Scouts can have television QSOs back and forth. We will also have code oscillator kits for them to solder together."

Photo A. April WA6OPS helped explain RDF to eager Scouts before they went out to hunt. Looking on is longtime Scouting supporter Darryl Widman KF6DI. (Photo by Joe Moell KØOV.)

The Simi Settlers' JOTA site would be Lake Casitas Recreation Area near scenic Ojai, California. Scouts from Ventura, Los Angeles and Santa Barbara counties were invited. Several hundred could be accommodated. The event would officially begin at noon Saturday and continue for 24 hours. Many Scouts would camp over Saturday night, while others would be at the lake shore for just a few hours on one day. Foxhunting at night would be unsafe, so we had to make it possible for many Scouts to hunt at the same time during our limited available hours.

Lake Casitas is a drive of over 100 miles for T-hunters in my area, but it is only about 40 miles from Santa Barbara, where there is a growing group of radio-orienteering enthusiasts. I own plenty of fox transmitters, but not enough RDF gear for dozens of Scouts to use. What's more, April and I would need knowledgeable helpers for one-on-one training of the Scouts. I zipped off E-mail to Marvin Johnston KE6HTS of the Santa Barbara Amateur Radio Club and he immediately agreed to help.

Having no experience with foxhunting demonstrations for pre-teens, I could only try to envision how it would go. I imagined that we would take the Scouts in packs or troops of a dozen or two and give them a quick show-and-tell on RDFing and map plotting. Then we would hand out some gear and send them into the woods to try to find five foxes transmitting for a minute each in sequence, just like they do in a formal international-rules competition (see "Homing In" for August and September 1996).

Greg surveyed topographical maps of the site and suggested a hilly area of about one square mile across the park road from the camping area. He even agreed to make lots of copies of that map for the Scouts. "Don't worry," he told me, "they are prepared for being in the woods and will bring compasses with them." Good, all I would need for orienteering would be a batch of protractors.

For a week before the event, I spent each evening tuning up my RDF sets and borrowing more. On Friday afternoon, April and I went to the site to check it out. I quickly realized that my imagination had not served me well. The hilly area was fenced off. No access! Oh well, it wasn't very shady. In truth, it looked like a barren home for rattlesnakes. Besides, it was too far away from the campsite.

We decided to hide the foxes within the large wooded JOTA campground, not far from our van where we were showing a video of international radio-orienteering competitions (see **Photo A**). Scouts would not have a long hike. We could easily watch and help. As a side benefit, the sight of them combing the grounds with sniffing gear would attract much more attention to our demonstration.

The two hundred or so Scouts that came to Lake Casitas were mostly in elementary school. They may be champs at the latest video games, but they had to start at square one when it came to RDF. No way could we simply slap gear into their hands and send them out. It worked best to guide them along in groups of two or

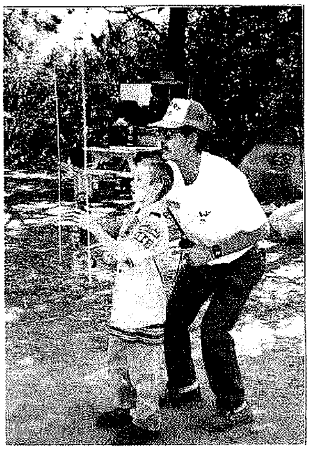


Photo B. Reg Reginato KE6ZQY of Santa Barbara shows a Scout how to use his dual-dipole TDOA RDF set in the JOTA-96 campground. (Photo by April Moell WA6OPS.)

three as they learned. One Scout at a time used the RDF set while the others watched. It would then be their turn to find the next foxes.

Five cycling intermittent transmitters proved to be too confusing during the learning process. We changed two of them to be continuous emitters on separate frequencies below 146 MHz, just for first-timers. One was in a surplus ammunition box while the other was the cleverly camouflaged "stud T" (see "Homing In" for October 1996). That one always got looks of amazement when the Scouts flushed it out. As time and equipment permitted, those who did well on continuous foxes could try to bag the intermittent ones on 146.565 MHz.

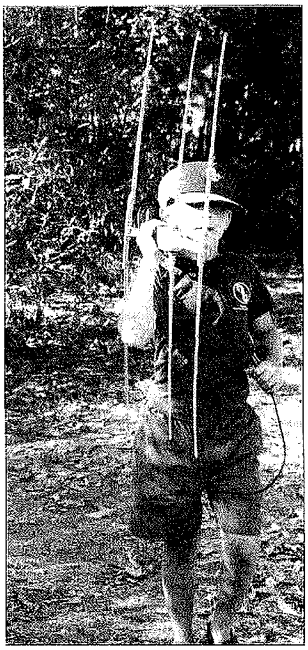


Photo C. To this Cub Scout, RDF gear seems a bit heavy after a few minutes of fox tracking. Next time, I'll add a mast so this Russian-made set can be held high more easily. (Photo by Joe Moell KØOV.)

Better tools needed

To regular users of VHF-FM, it's easy to gauge the strength of incoming signals by the amount of background hiss, or lack of it (quieting). But to a Cub Scout who has never held a handie-talkie before, it's not obvious. After some practice, a few of them did well at getting bearings with an HT, beam and active attenuator. Others couldn't seem to get the hang of it, especially if the HT didn't have an S-meter.

Other types of RDF sets were much easier for kids to learn. The Santa Barbara group brought several dual-dipole homing sets (TDOA type) with left-right indication (meter or LEDs). Although TDOAs are more prone to multipath bearing errors and they lack signal strength indication, the kids found them easy to learn and had good results (see **Photo B**).

In Europe and Asia, where radio-orienteering is a popular sport in schools, everyone uses special amplitude-based RDF sets for 2 meters. There are many variations, but they all incorporate a yagi or phased array antenna and a built-in receiver with wide-range RF gain control. Signal strength is indicated by a panel meter, tone pitch, or tone loudness.

I had only two of these foreign-made sets along, but I think they were easiest for Scouts to learn to use. All they had to do was turn the antenna for strongest signal indication and walk that way. Their excitement grew as signal strength rose and they had to lower the RF gain; it meant they were closing in. Bearings were nearly always accurate.

Weight was the biggest disadvantage of the integrated receiver/antennas. It surprised me how difficult it was for some grade-schoolers to hold a three-element 2 meter yagi overhead long enough to hunt down a hidden fox. Their arms would become fatigued in about three minutes and the beam would slip down to shoulder height (see **Photo C**). Of course that adversely affected the beam's sensitivity and directivity. In the future, I want to have lighter antennas with masts, so they can easily be held overhead.

Photo D. Who says Morse is dead? Another hit of JOTA-96 was this code oscillator kit project. (Photo by April Moell WA6OPS.)

Competitive foxhunters prefer using earphones to hear fox modulation and strength tones in noisy surroundings. That's why most foreign-made integrated receiver/antennas don't have speakers. But phones aren't ideal for one-on-one training. My solution was to have the trainee wear them around the neck instead of over the ears. With gain turned up, they put out enough audio for the trainer, the trainee, and observers to hear. As a bonus, this eliminated the chance of an audio blast directly into the ears if the RF gain control was improperly set when the fox came on the air.

More "fox people" needed

ARDF and kit building were smash hits at our JOTA operation. Lots of Scouts were beeping away on their newly-built code oscillators as they came up to the foxhunting display (see **Photo D**). Some older Scouts said they'd had lots of HF QSOs in previous years, so they were glad to have some new activities this time.

Most Scouts had an opportunity to track at least one fox Saturday afternoon. Darkness fell around 6 p.m. and it was time for a big spaghetti dinner around the campfire. Then we left them for the night, promising to charge up the fox batteries for more hunts the next day.

If there was any doubt that foxhunting enthralled the Scouts, it was dispelled Sunday morning. As we pulled into the campground, we were greeted with young voices shouting, "The fox people are here!" Before we could get the RDF gear out, were mobbed. Scouts who had hunted on Saturday wanted to try again, because the foxes were all in new locations. We gave first priority to those who had not gotten a chance to hunt Saturday; then we let the rest have at it again.

Hats off to the Simi Settlers Radio Club for going beyond the call of duty in providing a special JOTA experience for the Scouts. Special kudos to Greg and Gabriella for paving the way for ARDF events. Also thanks to foxhunting enthusiasts from the Santa Barbara Amateur Radio Club for helping. In addition to Marvin, they were Stephen Nelson KD6VEX, Nerella Reginato, Reg Reginato KE6ZQY, Brian Peddicord KF6DZN, Mike Peddicord KE6OTM, Scott Phillips KF6EDD, Hubert Stamps KC6NAH, Bib Ummels KE6WYA, and President Darryl Widman KF6DI.

Many Scout officials at JOTA-96 expressed interest in future foxhunting demos and activities for their dens, troops, and packs. Given enough inexpensive equipment and trained leadership, radio-orienteering could become a mainstream Scouting activity. I have lots of ideas for gear. But will Scouting organizations across the country be able to find enough T-hunters to get this program off the ground?

Are you "Homing In" readers willing to build and stockpile some kid-proof ARDF gear, seek out your local Scout leaders, and put on training sessions? I want to hear constructive opinions and ideas from both T-hunters and Scout leaders about this concept. Let's prove that we mean it when we say we want more young people involved in ham radio activities. Send E-mail to Homingin@aol.com or write to the address at the beginning of this column.

NEVER SAY DIE

Continued from page 56

make. If you use a half cup measuring unit you'll use one quart of yogurt and end up with about two quarts of dressing.

The olive oil is good for you, as are the apple cider vinegar, honey, and yogurt. The best part is that this helps you live longer so you can watch while your enemies die of heart attacks, cancer, and other eating diseases. Heh, heh.

The combo of the raw zizzed veggies and slaw dressing makes eating health food easy. Hey, give it a try. It might help keep you from becoming a veggie.

Government Control

The religious fervor over abortion, pro and con, seems to have blinded both sides to the realization that once they get the government involved in religion, they have started on the slippery slope toward the government domination and control of religion. Is that really what they want? The old camel's nose in the tent syndrome?

The pro-lifers want to use the government to force their beliefs on everyone, backed by our so-called "correctional system." The pro-choicers want to force *their* beliefs on everyone, via government control. If either side wins, we all lose.

The same holds for school prayer. The damned judges should stop trying to get involved with religion vs. the government. Heck, I sat through school prayers for years without being impacted one whit. It was one of those rituals which we did without thinking, like saluting the flag, which we used to do every day. You know, that "One

Continued on page 81

Number 59 on your Feedback card

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119
clhough@aol.com

A 1296 MHz Amplifier/ Mixer for Converter Use

With the coming of the new year and the holidays behind us, it's time to start getting our microwave and other projects off the back burner and start putting them together. Winter affects us in varying ways, with our many states and their vastly different geographical settings. For us here on the West Coast it means putting on a heavy shirt or light jacket for the chilly mornings, or getting prepared for our rainy season.

For other parts of the country with much harsher weather conditions this is truly the time for evening workbench projects. Last month we covered several older 2 meter multimode rigs, showing their use in SSB and narrowband FM operation as a lower-frequency IF system. This IF system is the heart of this RF converter, needing only a mixer, filter and local oscillator as additions for construction of a 1296 MHz converter.

Construction

This rig was quite easy to construct. While it is a peanut whistle (low power: +10 dBm), it is a complete rig needing only a local oscillator for operation. The beauty of this approach was that all the amplifiers are part of existing circuitry that is readily available. This circuitry requires only assembly into a shielded box to house the mixer, amplifier PC boards and relay switching circuitry.

This project was started when I tried to put together PC boards using MMIC amplifiers like the MAR series. This meant that I would have to come up with a PC board layout and select amplifiers to perform the receive and transmit functions of a low power RF controller. It was also intended to drive the transverter with a 2 meter multimode rig as the IF system in this project.

After several cuts at breadboarding this project I discovered that I did not need to construct amplifier chains as they were already at hand. The amplifiers came from Qualcomm surplus IF amplifier PC boards that I had available. They were originally a receive IF amplifier and a transmit IF amplifier using multistage MMIC amplifiers. Their small size, high gain and output power capability (+10 dBm on transmit) made them a very good candidate. The first breadboard test circuit was built using these IF PC boards, with a few other parts tossed in. These were simple RF relays, switching a mixer for converting frequency and a simple power supply regulator. Having all the material at hand and in modest quantity, allowing for others to use it, made this approach a natural for repeatability. First I had to construct a working model to prove that miniature inexpensive relays would function at 1296 MHz, thus eliminating expensive coaxial relays for low power switching.

I wanted used small surplus miniature SPDT relays removed from junk PC boards to switch the DC control voltages and the input and output RF switching as well. I was hoping that the RF losses would not

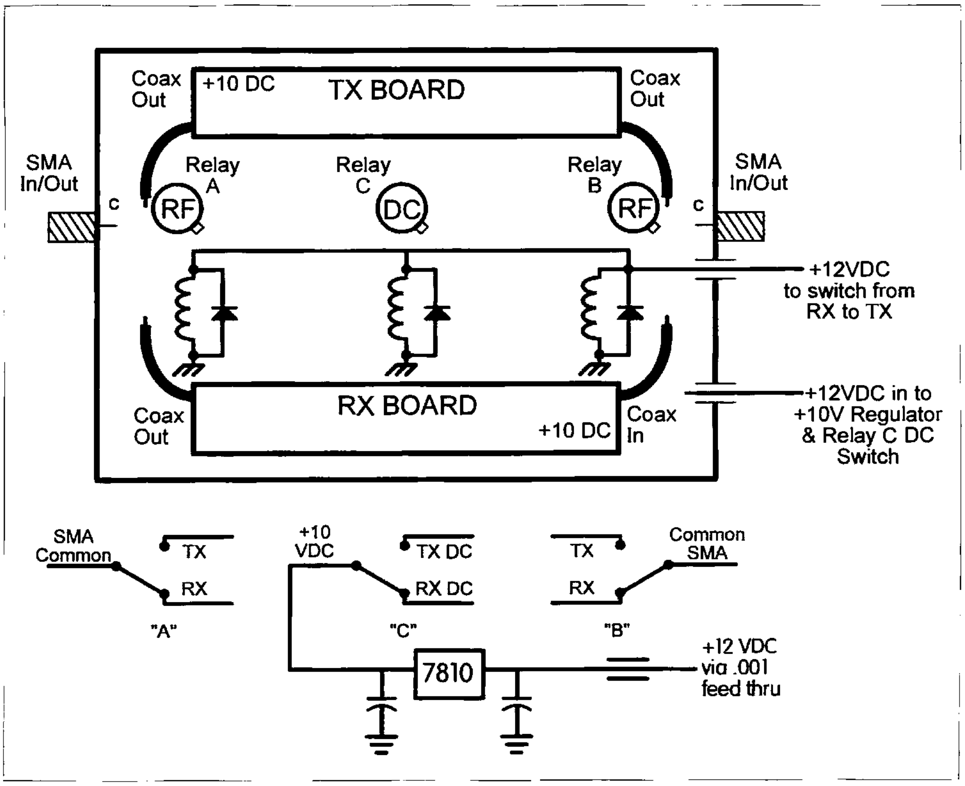


Fig. 1. Layout diagram of the amplifier converter unit.

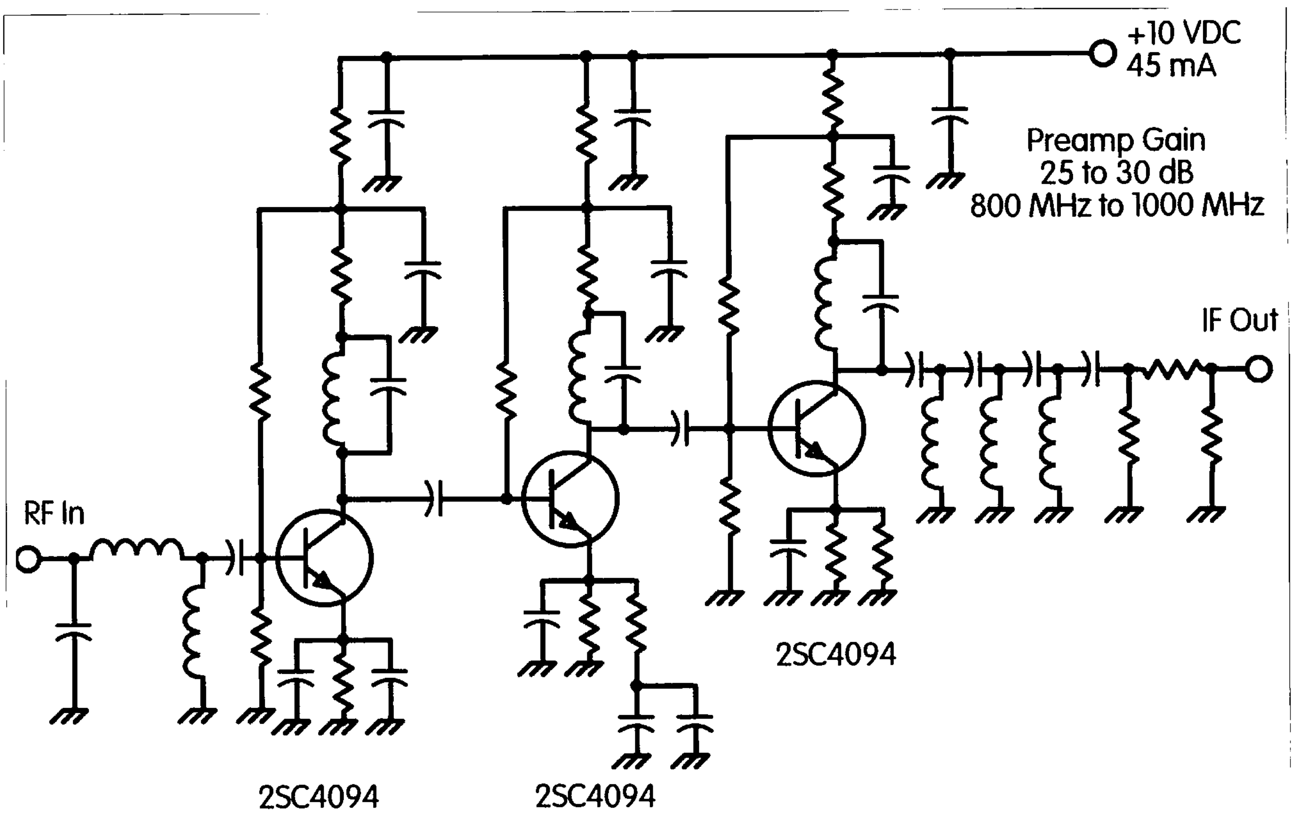


Fig. 2. Schematic diagram of the receive amplifier.

be excessive in these relays for 1296 MHz. The only way to prove this was to leave the theoretical environment and actually build the circuit as originally proposed.

The relays I selected were miniature metal-enclosed TO-5 relays manufactured by Teledyne. These relays are quite small and the exact size of a modest power transistor (TO- 5 metal-cased power transistor). I did not try the small 12 volt relays offered by Radio Shack (275-241) but I believe they should work in a similar fashion. The thing that is important about using any device at these frequencies is to make all leads as short as possible, especially the common ground leads. It is OK to make the RF amplifier leads longer.

I suggest mounting the relay upside down on a piece of copper circuit PC board blank. The entire copper foil of the PC board will serve as the ground shield and mount for all components. I used the position on the side wall for the coax connector in/out SMA connector to be exactly at the pin of the relay for the transfer contact. This gave minimum lead length to the relay by mounting it directly at the coax connector location.

What I have constructed is a reasonable layout that can be easily reproduced with the materials I will make available. However you are free to experiment and change the layout and application using the same components to suit your particular design requirements. In this case the old axiom applies: "If you change the recipe you might change the product." Give it a try if you like and watch for circuit layout and amplifier instabilities. Use similar PC board material of .062 double-sided copper to shield your circuit and connect the side plate with a seam of solder making a solid grounded enclosure. I soldered the side plates to each other and the bottom plate on the inside, connecting all copper foil surfaces together to form a shield.

Similarly a top cover is also cut out of PC board material to complete your RF-tight enclosure. See **Fig. 1** for the dimensions of the enclosure that I constructed. Dimensions do not have to be strictly adhered to; just follow something similar if you plan to use the IF amplifier boards that I will make available for this project.

The IF amplifiers that I used were surplus units removed from Qualcomm transceivers that we converted to 10 GHz operation. The specification on the receive RF amplifier is about 28 to 30 dB of gain and 2 dB noise figure making a very sensitive high gain RF front end. The transmit IF, or in our case RF amplifier, has less gain measuring 24 dB but it will provide a higher power RF output of nearly +10 dBm. While this is a peanut whistle (12 mW) it is still quite effective. External switching and a power amplifier will make this converter a formidable 1296 MHz transverter.

What I attempted to do is to provide you with the building blocks of circuitry to construct this converter. The thing that makes these amplifiers attractive is that they fit into this application like a glove. Their small size (1" x 3"), high gain and ready to place and play type of circuitry make them easy to use with +12 volt battery applications for home or portable rigs.

As I stated earlier, I will provide a mini kit of both the Rx and Tx PC boards with a 2000 MHz PC surface mount mixer and a short section of waveguide to construct an evanescent mode filter (see the end of this column for details). The only thing you will have to add is a local oscillator at 1152 MHz to complete the transceiver. That is if you also choose to use a 144 MHz transceiver for your IF system. The LO frequency would change if you change the IF frequency you use. If you used 432 MHz as the IF system frequency then the LO required would be 864 MHz.

Considering the 1152 there are several options on the LO, including a 96 MHz crystal oscillator followed by a times-three multiplier and double to 576 MHz, followed by a single doubler to 1152 MHz. An alternative would be to phase-lock up an old CATV front end on 1152 MHz for a very economical local oscillator. I have covered these for ATV projects and assume that with some modification they could adapt to this use as well. I used a different tack with a synthesizer that I had on hand.

This surplus synthesizer from Qualcomm is in small quantity and not easily available at present in the model that will generate 1152 MHz. We do have models that will lock up to 2304 MHz and, allowing for the onboard divide-by-two's reducing the LO to 1152 MHz, we might be able to tap off that line and use it in this application. I will have to try to find some time to try this modification and see if it is practical; more on this later. The actual synthesizer that I used is in the test bed area of my shack and I am in the process of documenting it. While it is an excellent choice, we do have a quantity of them and have not fully developed details for others to follow our conversion at this time. Also, this unit will prove to be costly because it comes equipped with a high quality 10 MHz TCXO on the PC board, this in addition to the 3036 synthesizer circuitry.

In the prototype conversion we were able to not only generate the required 1152 MHz for the converter's use at 1296 MHz transverter use, but also to use an additional oscillator port to drive a 3.7 to 4.2 satellite LNA by broadbanding its strip line circuitry to serve a harmonic amplifier. This LNA feeds a simple PC board antenna feed of triband proportions, making harmonics available for 2304 MHz, and 3456 MHz and higher harmonics available for calibration at other amateur frequencies. These frequencies are direct multiples of 1152 MHz.

I have tried both the CATV tuner's local oscillators and had some trouble increasing frequency higher to make it run at 1152 MHz. Normally the CATV tuner's upper frequency limits are near 1050 MHz and require modification to go higher. While the 3036-based synthesizer is much more complex, it is also the best local oscillator I have tried. However, it's somewhat expensive considering it comes with a 10 MHz high stability TCXO reference. Whatever local oscillator you select, this RF amplifier/mixer arrangement should prove quite easy to set up for a simple 1296 MHz converter.

The IF amplifiers provide gain over a 800 to 1700 MHz range. The receiver IF amplifier provides some 30 dB gain and exhibits a 2 dB noise figure, making a very good front end for a receiver converter. The transmit IF amplifier is also well suited for low power applications, or as a first driving amplifier. As it stands it provides +10 dB output power when driven from the mixer. Normally it has 25 dB gain but will only provide +10 maximum saturated out power in transmit. As both units run from a regulated +10 volts they are easy to use as they only require an input and output RF connection in addition to the +10 volts and ground.

In my application I mounted the amplifiers on the PC board with the receive amp facing forward or left to right, and the transmitting amp reversed with the receive amp. In this way I could use only one input and output RF connector and mount them on the side wall, which is about 3/4" high and constructed out of PC board material cut to length. All four sides are 3/4" high and soldered together. Another scrap of PC board material will serve at the top cover plate.

I mounted the two miniature TO-5 miniature relays as close to the coaxial connector for minimum lead length. I also soldered the relay coil with minimum lead length to ground. Place a rectifier diode across the relay coil for DC suppression. Position the other contacts as best you can to the input and output of the amplifier at their respective ends of the compartment. See **Fig. 1** for my particular layout. Exact replication of my layout is not necessary as long as your lead length is as minimum as you can make it. Remember that you are working at 1296 MHz and short leads are necessary.

The amplifiers both have input and output pads, making easy connection to their PC board circuitry. No adjustment or modification is necessary to their circuits; they can be used as they come. I soldered the PC board ground foil to the bottom circuit, making the amplifiers' PC board ground common and direct to the mounting bottom circuit board foil. I also mounted a third relay to switch the +10 volt DC line to either the Rx or Tx amplifier. Main DC input to the unit is 12 volts nominal and I used a 7810 voltage regulator mounted inside the case for the regulated DC supply.

This relay coil for the DC switch distribution is fed to an external key lead, making both the input and output coax (miniature TO-5 relays) switch when the DC control relay is also switched from this common key lead. In the nonkey condition DC power is supplied to the receive amplifier. When the key lead is energized the receive amp goes open and DC power is supplied to the transmitting amp and switching relay coils to energize them into operation.

This keying sequence can be changed to ground depending on your particular switching conditions. You don't have to follow my conditions; if yours are different make internal changes—don't modify your other equipment. If your keying conditions supply ground, tie the switching relay to +12 volts and run the open end to the switching lead. Bypass this lead with a feedthrough capacitor and ground to the transmit switch on this lead.

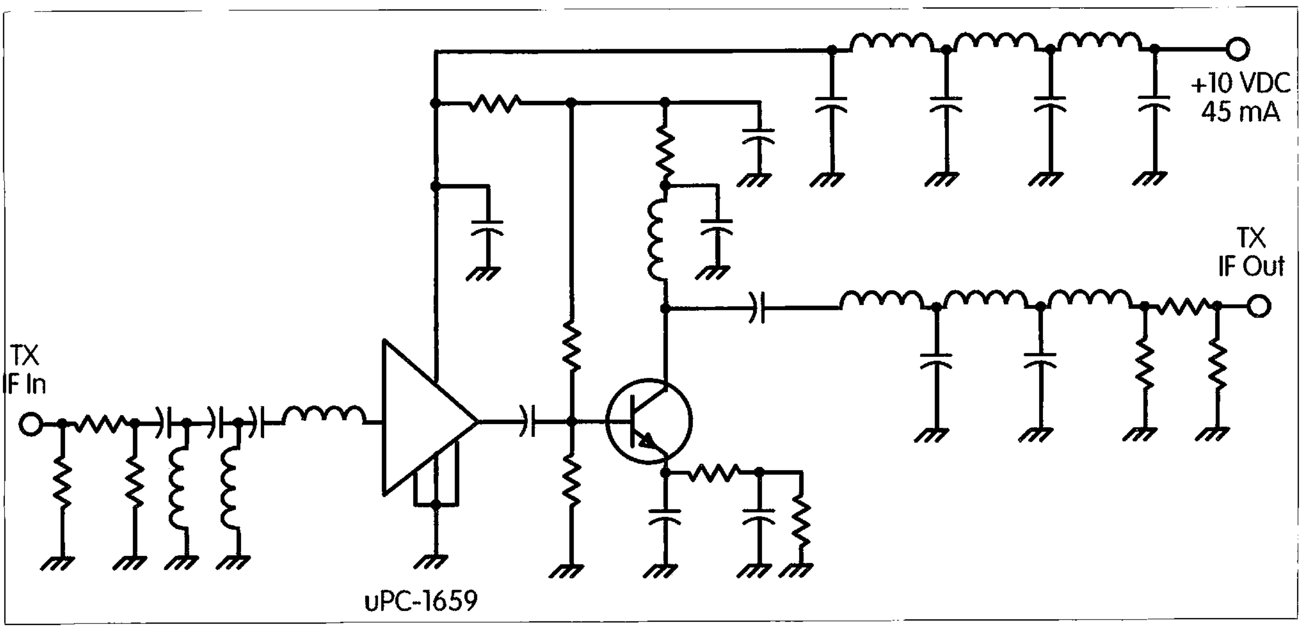


Fig. 3. Schematic diagram of the transmit amplifier.

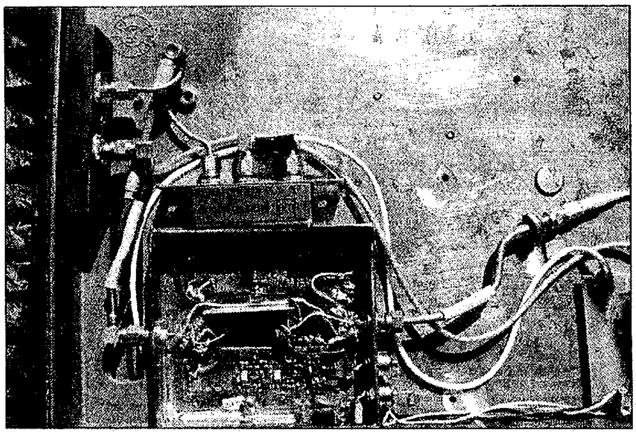


Photo A. *Completed converter unit, lower left corner of RF housing. Mixer mounted to upper part of converter case and waveguide filter (for 1296 MHz complete low level transverter system) to rear left of photo (requires LO at 1152 for complete package).*

Preventing trouble

The only important part of construction on this RF amplifier is to run leads to the input and output switching miniature relays in as short as possible a path to reduce loss and prevent unwanted stray effects like lead crosstalking, which is undesirable. What is lead crosstalking? Well, another term for this is the venerable alligator effect known as oscillation. The only difference between an oscillator and an amplifier is that a good functional amplifier will not oscillate. However, if you give this amplifier a chance by coupling between the input and output circuits it will take off and fly as a oscillator.

The best answer to preventing this effect is to bypass the power and switching leads with a feedthrough capacitor. Use small relays for coaxial switching, make ground connections as short as possible and use as direct wiring as possible. In some stubborn cases it might be necessary to construct some small case-high internal shields constructed out of small PC board scrap pieces and solder them to the common bottom ground surface to serve a grounded separator.

The cover plate can also be a source of trouble when it is attached. Let's suppose that you have just finished the amplifier/mixer unit and all tested out OK. It sounds just fine and you are satisfied with this amplifier and have tested switching and all is still OK. However, when you put the cover on the noise in your receiver increases or some other effect is in apparent, like the presence of "birdies in your receiver." What's up?

Well, chances are the container is acting like a short section of waveguide with an input and output connector serving as the connectors to a waveguide to coaxial transition, and we have resurfaced the old alligator trick again (when the cover is placed on the amplifier)! The solution is to remove the cover plate and place some black conductive foam and glue it to the inside of the cover plate. Other material can be used, even some iron particles from a smashed iron toroid core. What type of material to use? Well, it doesn't matter much as both the iron core particles and the black conductive foam present a very high impedance or resistance to RF from coupling between the input and output of the amplifier.

If you use broken ferrite core material, glue the small broken pieces to the underneath side of the cover plate. This also will help to place a lossy substance in the path of the oscillation, thereby reducing the case's susceptibility to aiding oscillation. If you can figure out where an amplifier is getting its coupling from input to output you can stop the oscillation using one of these tricks I just mentioned. It's not hard but it does take some small amount of time to make a very stable amplifier system when placed into metal containers. They all act like waveguide and couple so be careful and test each and every one you build to prevent unwanted oscillations.

Next month I will get into several dish antenna feeds that can be constructed, and cover several that were obtained from surplus.

Concerning the 800 to 1700 MHz amplifiers used in this month's project: I will make them available in a kit containing both the Rx and Tx amplifiers with a 2000 MHz surface-mount mixer and a short section of waveguide 17 to construct the evanescent mode filter, for $20 postpaid.

Well, that's it for this month. Next month I will cover microwave stripline tuning methods. 73 Chuck WB6IGP.

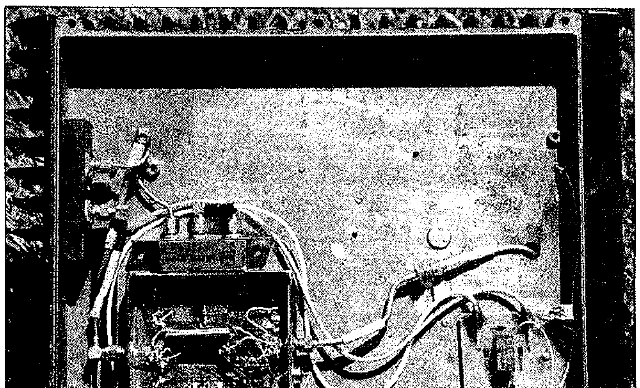


Photo B. *Full view of transverter package for 1296 MHz converter. Additional PC board on bottom right is RF relay switching for 144 MHz IF changeover.*

QRP

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

The days in January are always gray and cold in Ohio, so let's begin the new year with three construction projects. The projects are simple to build and they are useful, too. They're electronic keyers.

To make it easier for you to build these keyers, all the artwork has been laid out in Circad™ format. You can get a copy of Circad from any of the larger telcom suppliers. I know CompuServe has the latest version. AOL more than likely does as well. The demo version is usable, but some features are locked out. You can edit and print out these files with the demo version.

I will post all of the files for this column, except for Circad, in the HAMNET forum. Inside HAMNET, the files will be in the QRP library section. All three projects will be in the library, and one file will have all three projects together. So, you can download one, two or three files by themselves, or one file with all three projects. All files will be in ZIPPED format. You'll need PKUNZIP or another unzipping program to view the files.

Because I wanted as many hams as possible to give these keyers a try, subminiature parts and super-small PC boards were not used. Instead, the layouts are large enough so even a novice in home-brewing can have a very good chance of building a working project.

Two of the keyers were laid out by Jay Graswell WBØVNE. I worked on the last one, the DYI Plus keyer. One of the keyers is built on single-sided PC board; two require a double-sided PC board.

The Curtis keyer

The first keyer is a classic. Based on the Curtis keyer on a chip IC, the original project was done by Paul Page N1FB and Bob Shriner WAØUZO. The work appeared in the December 1983 issue of *QST* magazine.

Although many versions of the Curtis keyer have appeared, this version has most of the features, without making an overly complex project. Also, this version does not require a double-sided PC board.

Assembly is very basic. There's nothing really special to worry about. I would suggest, however, that you use a socket for the Curtis chip. The chip is a bit pricey.

As you can see in the overlay for the PC board, many of the controls for speed, sidetone volume and so on are mounted directly to the PC board. I would mount the speed control off from the board so you can easily change its setting. Aside from the speed control, leave the others as shown.

Your local Radio Shack™ should be able to supply you with almost everything you will need. Radio Shack also carries a nice selection of project boxes to put the keyer in. The PC board is a bit large to fit inside some of the QRP rigs out today. This keyer would be a excellent choice for a benchtop unit.

Radio Shack won't have the trimmers nor the Curtis keyer chip. You can get the trimmers and the Curtis keyer chip from Mouser Electronics, 1-800-992-9943. Point your browser at their World Wide Web address at www.mouser.com.

You can also obtain the Curtis chip from Jade Products at 1-800-523-3776. Their web site is: www.hampstead.k12.nh.us/~djade/index.html. Jade Products also sells a Curtis keyer kit at $46.20 PP. It is *not* the same one presented here, however.

Right now, I'm not sure PC boards will be available. It's possible I may be able to talk FAR Circuits into making some of the single-sided boards. I will let you know if any of the boards will be made.

The DYI Plus keyer

This is an old favorite of mine. This time around, I've changed the layout and put the circuit on a double-sided PC board. This makes the keyer much smaller than the original version on its single-sided PC board. And, there was enough room to add an extra transistor and a reed relay. This relay allows the keyer to key transmitters using emitter keying. If your QRP transmitter requires the emitter of the oscillator transistor to be pulled to ground, a transistor switch may not do the job adequately. The results are usually a bag of unwanted chirps and tweets.

Because the CMOS chips will operate on a wide range of power supplies, I did not use any inline regulators. I would steal power from a regulated source from your rig. The CMOS will be happy with anything between 5 and 16 volts. Current demand for either of the keyers in this trio is just about zip. Only the relay demands a stiff amount of current.

The relay I used in the DYI Plus is an off-the-wall item at Radio Shack. It comes in two different voltages: 5 volts and 12 volts. If you run your DYI Plus from a 12 volt source, guess what relay you should use? The relays have the following Radio Shack numbers: for 5 volts, 275-232; for 12 volts, 275-233. Mouser electronics also sells these relays.

When I did this version of the keyer, I added a header to the circuit board on .100 centers. My idea is to use those cute shorting jumpers and a header to select between relay keying and solid-state keying. There is no reason why you can't use a clipped resistor lead instead of the shorting jumpers. And, there is enough current from the 4027 to drive both transistors. This way, you could have two outputs, although why is beyond me.

Speaking of headers, I also laid out the board to accept .100" headers for the speed pot and all the I/Os. I just hate seeing a project with a zillion wires soldered in place. The use of the plug-in headers makes for a much cleaner installation. If you can train yourself to use a standard header, you could switch out one keyer project for another.

G3BIK's keyer

The last keyer in our trio is by G3BIK, and comes from the Oct. 1994 issue of *Radio Communication*.

The circuit is very similar to that of the DYI keyer. The difference lies mainly in the choice of ICs used. Instead of the 4011, a 4093 is used. A 4013 replaces the 4027 used in the DYI keyer. Also, this keyer has an onboard 1 kHz keying monitor. It will drive one of those piezo units. I'm not sure I would like to use one of those for sidetone monitoring!

Note that this keyer is laid out so it is very narrow and only one inch wide. It would fit along the backside of just about any QRP rig. The relay TX output will ensure total keying compatibility.

Assembly

No rocket science stuff here. If you have assembled a few kits now and then, you should be able to get all three of these to work.

The only cautions are to handle the CMOS chips carefully; they're subject to damage caused by static. The ICs must also be installed correctly. Reverse one and it's almost a sure bet it's toast. I'd use IC sockets, especially on the double-sided PC boards. The prototypes I made had plated through holes. If you decide to make your own double-sided boards, be sure to solder the connections on both sides of the board.

I'd use a 9 volt battery to test out these keyers. There's no need for large high-capacity gelled batteries. In fact, just in case you have something out of whack, you'll do little damage with the 9 volt battery. On the other hand, you can easily burn off copper traces with a gel cell.

I've built the DYI Plus keyer and the Curtis keyer board. They work just fine. I have not assembled the G3BIK keyer.

Again, I'll have all the files uploaded to the QRP section on CompuServe. And, of course, the QRP section is hiding inside HAMNET. If I come up with any changes to either the boards or the schematics, I'll have the updates in those libraries.

If there is enough interest, perhaps a small run of double-sided PC boards with plated through holes will be made for the DYI Plus keyer.

Next month I'll have some more odds and ends for various circuits you can use for your latest QRP projects.

Ham Radio Fun

Communications Simplified, Part 13

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

It's time to look at the transmission lines that connect the antenna to a receiver or transmitter.

Characteristic impedance

Let's review what we said about characteristic impedance earlier in this series. Think for a moment about how an ohmmeter works. Inside every ohmmeter is a small battery. When you connect the ohmmeter across a resistor, the meter connects that battery across the resistor. Current starts to flow through the resistor, the meter measures how much current there is, and computes the resistance from Ohm's law:

$$\text{resistance} = \frac{\text{voltage across resistor}}{\text{current through it}}$$

Now, imagine that you have an infinitely long length of some cable, such as the flat twin-lead cable used for TV antennas, and you connect the ohmmeter between the two wires at your end. What will you measure?

Connecting the ohmmeter to the end of your cable connects its battery across the two wires. The ohmmeter, of course, doesn't know whether there is an inch, a foot, or a mile of wire there, so it sends some current out its test leads, hoping eventually to reach a resistor at the end. Normally, the current would reach a resistor after going through just a few feet of wire, and settle down to whatever current Ohm's law wants. In this case, however, that test current just keeps going forever (at almost the speed of light), searching for a resistor that isn't there. The ohmmeter doesn't know that this test current never reached a resistor; it happily measures the current and voltage, and displays a value of resistance anyway.

The amount of current that flows depends on the kind of cable. Actually, its resistance has fairly little to do with it; it's the capacitance between the two wires and the inductance of the wires that mainly determine how much current flows down the cable. The resistance the meter measures therefore depends on the type of cable; we call it Z_0, or the *characteristic impedance* of the cable.

Different cables have different characteristic impedances—the TV twin-lead is 300 ohms, the coaxial cable used for TV antennas is 75 ohms, while the coax generally used for transmitting antennas is 50 ohms. And the twisted-pair cable generally used for audio and telephone circuits would measure 600 ohms.

Reflections

Now look at **Fig. 1.** Here we see a simple circuit, consisting of a 10-volt battery, a switch, and a 10-ohm resistor, all connected in series. Right now, the switch is shown open, and so there is no current. Once we close the switch, current starts to flow. The value is given by Ohm's law as V = I/R; this works out to 10 volts/10 ohms, or 1 ampere.

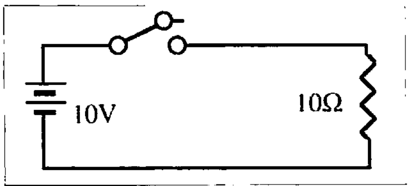


Fig. 1. A simple series circuit.

But let's complicate the issue a bit by making the wires between the switch and the resistor 186,000 miles long. To simplify things a bit, let's assume that the wire has no resistance, but it does have a characteristic impedance Z_0 of perhaps 100 ohms. What is the current just after we close the switch?

Since it takes light one second to travel the distance from the resistor to the switch and battery, even if the battery had a high-power telescope so it could "see" the resistor at the far end, it could still not know precisely what is at the end of the wire at the instant the switch closes—it could only see what was there one second earlier. So, as before, the current it sends out depends not on the resistor, but on the characteristic impedance of the line. The current is therefore:

$$I = \frac{10 \text{ volts}}{100 \text{ ohms}} = 0.1 \text{ ampere}$$

So, if we had a voltmeter and ammeter connected at the switch, we could see 10 volts and 0.1 ampere entering the line as soon as the switch closes. A half-second later, that voltage and current reach the middle of the line; one second later they finally reach the resistor.

The problem is that 10 volts and 0.1 ampere are all wrong for a 10-ohm resistor. By Ohm's law, if there is 10 volts, there should be 1 ampere; if there is only 0.1 ampere, then there should be only 1 volt. The resistor therefore looks at the voltage and current reaching it, and says "No, no, no—something is wrong—there is either too little current, or too much voltage—or perhaps both!"

The resistor therefore short circuits some of the applied voltage to bring it closer in line with what should be there, considering the amount of current. This temporary short circuit causes an additional current to flow through the resistor as well.

This situation, however, leads to a contradiction. At the resistor, the voltage is now lower than 10 volts while the current is slightly higher than the original 0.1 ampere. However, a short distance back from the resistor the line voltage and current are still 10 volts and 0.1 amperes. But this can't be! In a parallel circuit, the voltage must be the same everywhere, while in a series circuit the current should be the same as well. And so the drop in voltage and increase of current must start to travel back along the line, eventually making the voltage and current the same everywhere.

One way to look at this is to think of an outgoing signal (10 volts and 0.1 amperes) traveling from the battery to the resistor, and a second, returning signal, traveling back from the resistor toward the battery. The returning signal adds to (or subtracts from) the outgoing signal, changing the total voltage and current along the wire. In technical terms, we say that the returning signal is a *reflection* —part of the outgoing voltage and current have been reflected from the load, and travel back along the line.

The reflection will eventually reach the battery, which will look at the lower voltage, and do everything it can to boost it back to the required 10 volts. In the process, it will send out a burst of more voltage and current (but still the wrong values). These will go back to the resistor, cause yet another reflection, and so on. Eventually, the voltage and current will stabilize at the 10 volts and 1 ampere that DC circuit theory says we should have.

We can calculate how much voltage is reflected from the *reflection coefficient*, represented by the capital Greek letter gamma:

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$$

where Z_L is the value of the load resistor (100 ohms in this case), while Z_0 is the characteristic impedance (which is 10 ohms in our example). So in this case, the reflection coefficient is:

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} =$$

$$\frac{100 - 10}{100 + 10} = \frac{90}{110} = 0.818$$

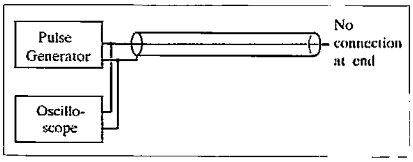


Fig. 2. Time-domain reflectometry.

What this means is that 81.8% (a fraction of 0.818, or 8.18 volts) of the outgoing 10 volts will reflect off the 1-ohm resistor. The voltage across the resistor will then be 10 - 8.18 = 1.82 volts. Knowing how much voltage will actually reflect is nice, of course, but it's more interesting to look at three special cases.

Case 1: There is no load resistor at the end of the cable at all—the output is open. In this case, Z_L is infinity, and the equation becomes:

$$\Gamma = \frac{\infty - Z_0}{\infty + Z_0} = \frac{\infty - 10}{\infty + 10} = \frac{\infty}{\infty} = +1$$

That's because the infinity on the top and bottom are so big that we might as well ignore the Z_0. So, with the output open, the reflection coefficient is +1, and 100% of the outgoing signal is reflected.

Case 2: If, on the other hand, the end of the cable is shorted, then Z_L is zero, and the equation becomes:

$$\Gamma = \frac{0 - Z_0}{0 + Z_0} = \frac{0 - 10}{0 + 10} = \frac{-10}{+10} = -1$$

In this case, the reflection coefficient is -1, and so -100% of the outgoing voltage is reflected. That is, it is all reflected, but the polarity changes (that's what the minus sign means). That makes sense, since the voltage at a short circuit must be zero; the only way to get this is if the outgoing voltage and the returning voltage exactly cancel each other out.

Case 3: Suppose, on the other hand, that the load resistance Z_L is exactly equal to Z_0? In that case, the numerator of the equation becomes $Z_0 - Z_0$, which is zero. The reflection coefficient is therefore zero, and nothing is reflected at all.

So we see that the only way to get no reflection is to load the end of the line with a resistance exactly equal to the characteristic impedance of the line itself.

Let's see how reflections in cables can cause problems.

Reflections in digital circuits

Fig. 2 shows a simple test circuit which we can rig up in the lab. At the left we have a pulse generator; the pulse generator acts sort of like a battery and switch, except that it closes the switch only for a very short time (sometimes as short as just a few billionths of a second). In other words, it connects a voltage to the line for a tiny instant, and then immediately disconnects it again. The pulse generator feeds a length of transmission line (we use 100 feet of RG-58 coax cable in our lab experiment), whose far end is shown open. A fast oscilloscope is connected across the pulse generator to show us the signal.

Fig. 3 shows the result. The fairly sharp pulse at the left is the signal coming out of the pulse generator. It appears as a narrow pulse, on for just a very short time. The slightly smaller pulse at the right is what comes back from the end of the line—this is the reflection. It is slightly smaller, because there is about a 10% loss of voltage in going down the cable and back (this is, after all, a practical cable, not a theoretical, loss-free one). Note also that the returning pulse is slightly wider and not nearly as nice and square. This is caused by the various parts of the pulse traveling down the cable at slightly different speeds, which results in the pulse spreading slightly.

From this picture, we could calculate the signal loss in the cable; much more interesting, though, is to calculate how fast the signal travels. In this picture, the scope sweep was set to 0.05 microseconds per division; since the spacing between the two pulses is about six divisions, the delay between the outgoing and returning pulses is about 0.3 microseconds. In that time, the pulse traveled 200 feet (100 feet from the generator to the end, and another 100 feet to return). The signal velocity is therefore:

$$\text{velocity} = \frac{\text{distance}}{\text{time}} = \frac{200 \text{ feet}}{0.3\ \mu\text{sec}} =$$

$$6.67 \times 10^8 \text{ feet/sec}$$

Since there are 5,280 feet in a mile, this works out to about 126,000 miles per second. Note that this is slower than the speed of light, which is usually given as 186,000 miles per second; this latter figure is only true for light in a vacuum anyway, not for light in air, glass, or other materials.

In our electrical case, the speed of the signal in the cable is only about 67% of the speed of light; we call this number the *velocity factor* of the cable, and usually write it as 0.67 rather than 67%. (Remember that our measurement is only an approximation; the actual published velocity factor for RG-58 cable is slightly less, but the delay time is hard for us to read from the scope, and so 0.67 is about as close as we're going to get.)

The velocity factor is thus:

$$\text{velocity factor} = \frac{\text{actual speed}}{\text{speed of light}}$$

Now imagine that the pulse in **Fig. 3** is just one of many pulses being sent in a cable, perhaps as part of a computer local area network. If the end of the cable is open, then the pulses reflected from the end will get mixed in with the outgoing pulses and cause major errors in the system. So reflections can be a big problem.

Fig. 3 dealt with a line whose far end was open. If the far end had been shorted, there would still be a reflection, but the reflected signal would be negative instead of positive.

From our previous discussion, we can now see that the only way to prevent reflections is to make sure that the end of the cable is properly terminated—we must place a resistor at the end of the line, and make sure that its resistance is equal to the characteristic impedance of the line. If the resistance is slightly off, there will be a reflection, but it might not be large enough to matter. In general, a resistance larger than the characteristic impedance will provide a positive reflection; a resistance smaller than the characteristic impedance will provide a negative reflection. Thus the cables in local area networks are always connected to a load resistor at the end; sometimes the resistor will be inside the computer interface card, other times it may be mounted externally, but it will always be somewhere. And since the signals in these cables can travel in either direction, there will be a termination resistor at each end of every cable.

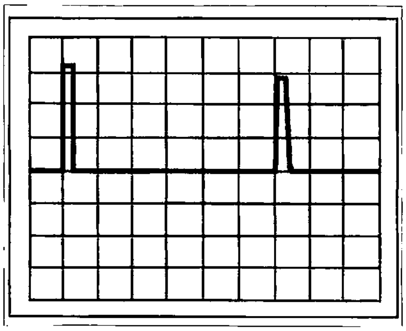


Fig. 3 Reflection from an open circuit.

Incidentally, putting a proper load resistor at the end of the cable is not enough—*how* you connect it is important too. If that resistor is right at the end of the cable, with short leads, all is fine. But **Fig. 4** shows what happens if that resistor is connected with foot-long clip-leads. There is still a small reflection; in fact, there are now *two* small reflections. At point A is a small positive reflection, caused by the clip-leads. The two clip-leads make a small transmission line, but its characteristic impedance is higher than that of the coax cable. So we get a positive reflection at this point. A foot later, the termination resistor has a lower resistance than the clip-lead impedance, and so we get a small negative reflection at point B. This points out that this type of test, called *time-domain reflectometry* (or TDR) because it measures the reflections and the time they occur, lets us analyze the locations of shorts and opens, as well as the locations of bad connections. Commercial TDR instruments are thus very useful for finding problems in buried or hidden cables.

Reflections in analog circuits

Analog signals can be reflected from the ends of cables just as digital ones can. For example, consider the antenna lead from a TV antenna to the TV set. To prevent reflections, the characteristic impedance of the cable usually matches the impedance of the antenna, and the impedance of the TV set's antenna input. Since there are two kinds of common antenna leads in use—the flat "twin-lead" cable which has a Z_0 of 300 ohms, and TV coax with a Z_0 of 75 ohms—many TV sets have two separate inputs as well. TV antennas usually have a 300-ohm connection, but we often use a 75- to 300-ohm transformer to match it to coax cable. (There's a second reason, too—the 300-ohm twin-lead is a balanced lead, whereas the coax is unbalanced, so slightly different connections are needed.)

Why the careful impedance matching? Because reflections can cause delays. If some of a received TV signal went directly to the TV set, while a small portion of it was reflected from the set back to the antenna, and then reflected a second time from the antenna back to the set, the TV set would get a weak signal shortly after the main, strong one. This would cause a ghost image to appear to the right of the main image. (If you get ghosts in your TV image, don't immediately blame the antenna installation. Ghosts are also often caused by reflections from nearby buildings, hills, or other large objects.)

But there is a second way to look at reflections of analog signals. Let's suppose that the signal entering the coax line in **Fig. 5** is not a pulse, but a sine wave. The reflection will then also be a sine wave, rather than a pulse. Depending on the length of the line, that reflection could arrive at the beginning of the line at various times. So let's examine a few special cases.

Case 1: Suppose that the line is exactly one-quarter of a wavelength long, and its far end is open-circuited. We earlier defined a wavelength as the distance a signal travels in the time of one cycle. The equation for the wavelength lambda was:

$$\lambda = \frac{\text{velocity}}{\text{frequency}}$$

For the velocity, of course, we now have to take the velocity in the cable, and we have already learned that this velocity is smaller than the speed of light in a vacuum; it is the speed of light times the velocity factor for the particular cable.

Let's put some numbers on this. Suppose we use an RG-58 cable with a velocity factor of about 0.65, and a

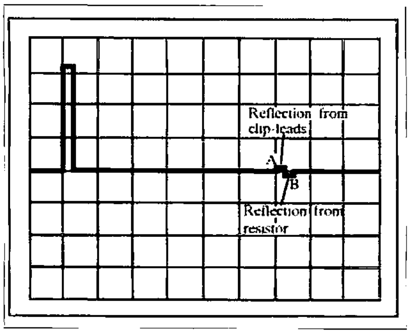


Fig. 4. Reflection from a bad load.

frequency of 1.6 MHz. One wavelength is then:

$$\lambda = \frac{186{,}000 \text{ miles per second x } 0.65}{1{,}600{,}000\,\text{Hz}}$$

$$= 0.0756 \text{ mile}$$

which is about 399 feet. A quarter-wavelength is then about 100 feet.

So let's take 100 feet of RG-58 cable, leave the far end open-circuited, and send a 1.6 MHz signal into it. The signal will take exactly one quarter of a cycle to travel down to the end. Since the end is open, the reflection coefficient Γ is +1, and so the signal is completely reflected. It now takes a quarter of a cycle to travel back to the beginning of the line, arriving exactly one-half of a cycle after it started. Assuming a low-loss line, the signal coming back will be almost exactly the same size as the outgoing signal.

The only problem is that the returning signal is now exactly one-half of a cycle behind the outgoing signal. In other words, the positive half-cycle of the sine wave arrives just as the signal generator is producing the negative half-cycle. And so the positive and negative half-cycles exactly cancel, producing 0 volts at the input into the line. The oscilloscope will see nothing.

Let's think about this for a moment. The signal generator in **Fig. 5** is generating a voltage (we didn't specify how big) but the actual voltage measured by the scope at the input into the line is 0 volts. How can that be? The only possible explanation is that the transmission line behaves like a short circuit. There is current, but no voltage.

We can summarize this as follows: *A quarter-wavelength transmission line which is open-circuited at the far end behaves like a short circuit at its input.* It may be a bit hard to believe, but it is true.

One more thing: The generator, thinking it is feeding a short circuit, is outputting more than its normal current, trying to overcome that short. So the input to the line is a point of zero voltage, but higher than normal current.

Case 2: Let's now take a similar case, but instead of leaving the far end of the line open-circuited, let's short it and see what happens as the positive half-cycle part of a sine wave leaves the signal generator.

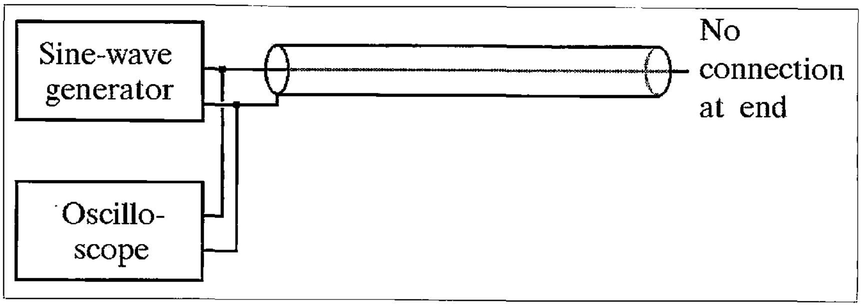


Fig. 5. Reflection of a sine wave.

The signal takes a quarter of a cycle to reach the short. Because the reflection coefficient Γ at a short is equal to -1, the positive half of the sine wave is completely reflected, but the minus sign means that it becomes negative rather than remaining positive. This signal now takes another quarter of a cycle to arrive back at the signal generator, arriving exactly a half of a cycle after it left.

Let's stand back and think about this for a moment. The positive half of a cycle left the generator, was inverted at the reflection, and returns just as the generator is outputting the following negative half of the cycle. The generator is now trying to output a negative voltage, but there is already a negative voltage on the line. So the generator doesn't really have to do anything to make the voltage negative. Hence it does not output any current. How can that be? The only possible explanation is that the transmission line behaves like an open circuit. There is a voltage, but no current.

We can summarize this as follows: *A quarter-wavelength transmission line which is short-circuited at the far end behaves like an open circuit at its input.* This, too, may be a bit hard to believe, but it is true. Given the right test equipment, you can prove it for yourself.

We can extend this idea to other lengths of cables. For example, the cable in **Fig. 6** is 3/4-wavelength long. What do we see if we look into the input?

Let's imagine that the line is split into the three parts labeled **A**, **B**, and **C** in **Fig. 6**, each part a quarter of a wavelength. Since the right end of part **C** is open, the left end of it looks like a short. Part **B** is therefore shorted at the right, so its left end looks open. Finally, part **A** sees an open at its right end, so its left end looks like a short. So a 3/4-wavelength line which is open at the far end looks like a short at its input.

We can extend this reasoning to any line whose length is some multiple of a quarter-wavelength, and which is either shorted or open at its end. But what about other lines?

More complicated cases

In most cases, transmission lines will not be an exact multiple of a quarter-wavelength, and they will not have an exact short or open at their end. What then?

The mathematical analysis of such cases is fairly difficult, and most professionals will use a special kind of graph called a Smith Chart to figure out what happens. But even without the Smith Chart, we can still get a general idea of what is going on. So let's consider the case in **Fig. 7**, where we see a transmitter feeding a 75-ohm load (most likely an antenna) through a 50-ohm transmission line that is 1.68 wavelengths long.

Because the load resistance is not equal to the line's characteristic impedance, there will be a reflection. The reflection coefficient is:

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{75 - 50}{75 + 50} = \frac{25}{125} = 0.2$$

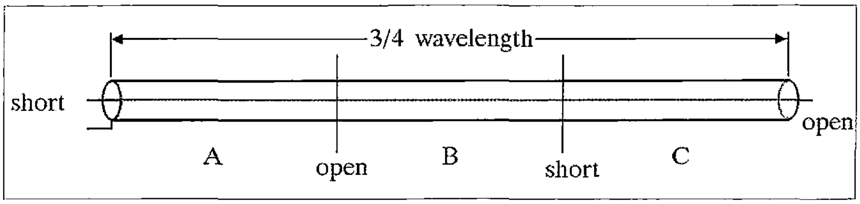


Fig. 6. A 3/4-wavelength line.

73 is accepting manuscripts for the June 1997 Field Day Issue.

If you had a good time at that last Field Day, or have ideas about how to make the next one a big success, submit your manuscript on a 3-1/2 inch disk, along with a print out and photos, by the end of February, to: Joyce Sawtelle, 73 Amateur Radio Today, 70 Route 202 North, Peterborough NH 03458.

Time's almost up, so if that manuscript file is still hiding the depths of your computer waiting for the spell-checker, drag it out of there and put it in the mail.

The best way for you to fill this magazine with what you most want to see is to fill it yourself.

so 20% of the outgoing voltage is reflected back to the transmitter. Let's assume that the transmitter is putting out 10 volts of RF; the reflected voltage is then 2 volts. This is obviously not good, because the load is not getting as much power as it should.

As the reflected signal goes back to the transmitter, there will be points along the cable where the reflected voltage will add to the outgoing voltage, giving us more than 10 volts. This voltage is called V_{max}, and is equal to:

$$V_{max} = V_{forward} + V_{reflected}$$

In our example, this voltage is 10 + 2 = 12 volts.

At the same time, there will be other places along the line where the two voltages are opposite, and so they subtract to give:

$$V_{min} = V_{forward} + V_{reflected}$$

In our example, this voltage is 10 - 2 = 8 volts.

Ideally, if the load was perfectly matched to the line, there would be no reflected voltage, and so V_{max} and V_{min} would be equal—the voltage would be the same 10 volts everywhere, and there would be no maximum or minimum. But that seldom happens exactly.

The presence of maxima and minima means that we can take measurements along the line, and find these points of maximum and minimum. This is not particularly practical with coax cable, but it can be done with open-wire balanced lines, where you can easily get to the wires to take voltage readings between them It is also sometimes done with microwaves: microwave signals (i.e., signals with a very high frequency on the order of gigahertz) are usually carried in waveguides (more on these later). It's possible to cut a slot into a waveguide and insert a small probe to take voltage readings inside it. This can be used to measure the VSWR, but it can also be used to find the frequency. Because the distance from a maximum to a minimum point is a quarter-wavelength (and the distance between two minima is therefore a half-wavelength), this can be used to measure the wavelength of a signal. If you know the speed of the signal in the waveguide, you can then calculate the frequency.

We say that these minima and maxima indicate the presence of *standing waves* along the line, and then define a *standing wave ratio* (also called a *voltage standing wave ratio* because we measure the voltage), abbreviated as SWR or VSWR:

$$VSWR = \frac{V_{max}}{V_{min}} = \frac{V_{forward} + V_{reflected}}{V_{forward} - V_{reflected}}$$

In our case, this is 12/8 or 1.5.

In the best case, if V_{max} and V_{min} were equal, the VSWR would be 1; many people read this as "1 to 1" or 1:1.

In the worst case, when *everything* is reflected, $V_{forward} - V_{reflected} = 0$ and the denominator is zero, so the VSWR is infinite. So measuring the VSWR is a common way of checking whether an antenna is well matched to the transmitter and its feedline. (It is not a perfect measure, because a resistor load equal to the transmission line's characteristic impedance would produce no reflections, yet obviously radiate no signal into the air!)

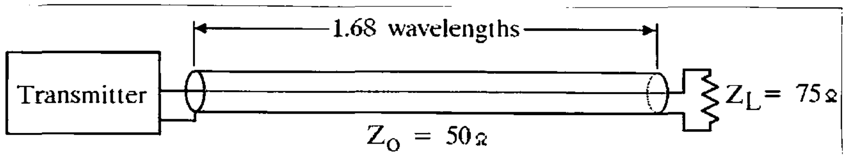


Fig. 7. A more typical example.

73 wants your feedback... we've been improving *73* for the past months with more articles, easier reading type, etc. And honestly, we *need* your feedback (in detail) if you have any critique either for or against the subtle changes that we've made. We know we can't please everyone every time, but if you tell us what you want *73* to be, we'll at least try to head in the direction for further "improvements" that might be most appealing to you. Thanks.

Build a Well-Regulated Power Adapter

Add some stability to your plug-in wall transformer.

James Tarchinski N8PTG
3135 Primrose Drive
Rochester Hills MI 48307

As you flip through the pages of *73*, or any other source of electronics circuit information, you'll find that many of the circuits either incorporate or need to be powered externally by a positive 5-volt DC power supply. Five-volt supplies are by far the most common supply value used for today's electronics. Knowing this, one would assume that there must be dozens of 5-volt regulated DC power adapters on the market, right?

Wrong. The free enterprise system has missed the mark on this one—regulated 5-volt adapters are nearly nonexistent, so electronics hobbyists often end up incorporating supplies into their project designs. In fact, they tend to design and build these supplies over, and over, and over again. But you don't have to keep repeating yourself—there is a better way.

Wall adapters can provide a convenient way of powering your electronics projects; you just need to modify them so they have the correct output characteristics for just about any regulated voltage that you will ever need! Because everyone has a different application with different design criteria, however, we do not go through one particular design. Rather we will discuss how to modify wall adapters in general, concentrating particularly on how to modify an adapter electrically without reworking the basic packaging of the unit's electronics.

A bit of history

The consumer electronics industry as we know it today would not exist if it were not for "industry standards." Industry standards are essentially gentlemen's agreements among companies stating that they will all produce products that utilize a standard format for something. This type of arrangement allows companies to save money by jointly developing a new technology, but yet they can each make money by selling their own unique products.

For example, before any company sold a compact disc (CD) player, all the major audio manufacturers of the world agreed on the specifications for the disc format. From the

#	Labeled Voltage	True Voltage	% Error
1	+5	5.10	2.0%
2	+5	9.65	93%
3	+6	7.94	32%
4	+6	8.42	40%
5	+9	10.34	15%
6	+12	12.38	3.2%

Table 1. *"Don't believe everything you read." The true output voltage can differ from the rated voltage in a random sampling of DC adapters. Adapter #2 was the worst unit tested, with an output nearly double the voltage listed on its case.*

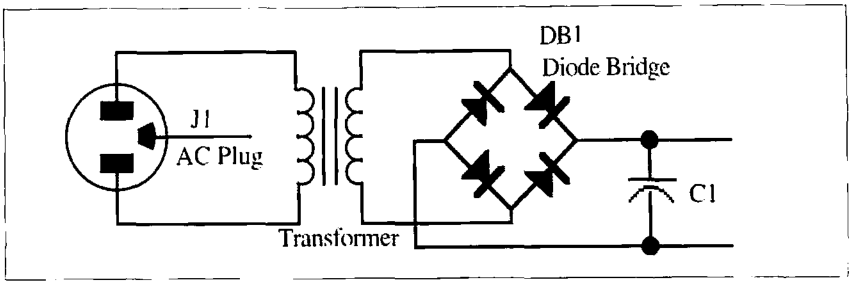


Fig. 1. The basic type of power adapter. The lack of any semiconductor regulator devices helps to keep the adapter's cost down, but it also keeps the unit's usefulness down.

consumer's point of view the end result was that you can now listen to the same CD on equipment made by RCA, Sony, Tandy, or any other of several dozen different manufacturers. When you bought your equipment you didn't have to choose between a RCA player and disc format or a Sony player and disc format. We were not so lucky when it came to other areas of home electronics.

Of course, VCRs come to mind. When these devices first hit the market they came in two flavors: VHS and Beta. After years of battling, VHS finally won and the Beta format went the way of eight-track players. Those people who backed the Beta format were the big losers, as they ended up with machines that no longer have tapes available for them.

Another area that still suffers from a serious lack of standardization is that of the AC-to-DC power supplies that are used with consumer electronics equipment. These supplies can be found in any voltage that is a multiple of 1.5 volts, from 1.5 to 13.5 volts. Furthermore, there are numerous different styles and even sizes of plugs currently used with these devices. And finally, there are plugs on the market that are wired with either polarity—with the tip being positive and the ring being negative, or vice versa.

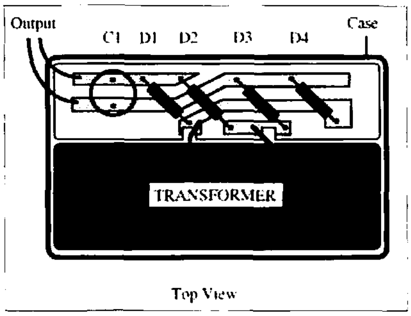


Fig. 2. In spite of the limited number of components stuffed into the enclosure of an off-the-shelf power adapter, there is not generally much space available for expansion.

Another problem with plug-in AC-to-DC supplies is that they don't always output the voltage indicated on their cases! To illustrate this point, I surveyed six different supplies, each made by a different manufacturer. While in the best case the actual output voltage was within 2% of the rated voltage, the worst-case supply was off by a whopping 93% (see **Table 1**).

There are a number of reasons why the actual output voltages of supplies are so different from their specified values, but by far the most common is cost. In order to make the supply as cheap as possible, most do not have solid-state regulators incorporated in their design, so their output varies directly with the line voltage supplied by the power company. Also as a cost-cutting measure, very liberal tolerances are used in the manufacture of these devices, and there is generally a lot of unit-to-unit variability in performance.

The load being driven by the supply is also an important factor in determining its net output voltage. For the data presented in **Table 1**, all the supplies were tested in their open-circuit configuration. But when an adapter is supplying its rated current the output voltage will almost always drop below its open-circuit voltage. Other than by testing the adapter under different loading conditions, there is no way to predict how far the output voltage will fall.

The variability of a power adapter's output is the main obstacle to using it to run circuits containing integrated circuits. One of the simplest ways of overcoming this obstacle is to install a voltage regulator on the DC output side of the adapter.

The electrical design

Fig. 1 is the schematic for a very simple AC-to-DC converter, while **Fig. 2** is the associated board layout. As you can see, the circuit contains nothing more than a standard full-wave diode bridge rectifier and a single filter capacitor. While this design is cheap, the voltage output is not very stable and therefore probably not suitable for any of your projects that use integrated circuits.

The circuit can be easily modified to incorporate a regulator, however. It is the job of the regulator to stabilize the adapter's DC voltage over a wide range of input voltages and output currents.

One of the most commonly used types of voltage regulators is the 78xx series. Low cost and the availability of several regulation voltages are among the reasons for the popularity of this line. **Table 2** is a list of regulators included in the 78xx series.

Fig. 3 is the pinout of a 78xx regulator in a TO-220 case. When viewed from the front, the leftmost pin (pin 1) is the input voltage line, which must be supplied with an input voltage that is at least 3 volts greater than the device's specified output voltage. Pin 2 of the device

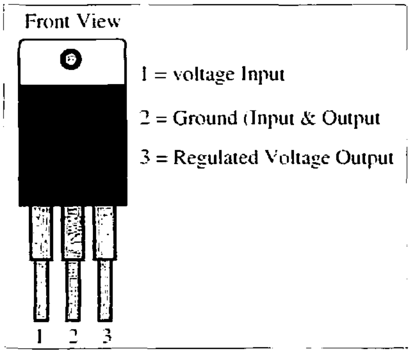


Fig. 3. Pinout of the 78xx series of voltage regulators.

is the common (ground) line shared between the input and output pins. Finally, pin 3 is the output line, which distributes the regulated voltage.

It is a simple matter to incorporate a 78xx series regulator into the basic power adapter design just described, creating a wall adapter with a well-regulated output. **Fig. 4** shows how this is done.

The power adapter you start with will need to have an output voltage, before modification, of about 3 to 5 volts higher than the regulated voltage you'd like to achieve. This requirement is imposed by the 78-series regulators, which need to see the higher voltage in order to regulate properly. If you refer again to **Table 1** you'll see that this should not be a problem, as most adapters output a higher voltage than specified on their labels.

Besides the regulator itself, only a few additional capacitors are needed to filter both the input and output voltages. The large caps are used to "smooth out" the voltage produced by the full-wave rectifier, storing energy for when the input AC signal changes direction. The smaller caps are used to filter out high-frequency noise, since they tend to look like short to ground to high-frequency signals.

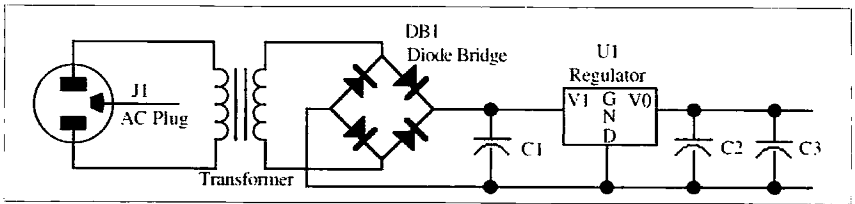


Fig. 4. The most straightforward method of integrating a voltage regulator into a basic power adapter circuit.

Don't lose your cool!

While it is easy to design a 78xx device into an adapter circuit, here's a strong word of caution about the amount of current these regulators can supply: The current values listed in **Table 2** represent the maximum amount of current that can be supplied when they are mounted so that they have adequate cooling. In order to obtain "adequate cooling," you must generally use some form of heat sink to help dissipate the heat generated by the regulator.

Output Voltage	Output Current	Part Number	Package Style
+5	100mA	78L05	TO-92
+5	1A	7805	TO-220
+6	1A	7806	TO-220
+8	100mA	78L08	TO-92
+8	1A	7808	TO-220
+12	100mA	78L12	TO-92
+12	1A	7812	TO-220
+15	100mA	78L15	TO-92
+15	1A	7815	TO-220
+18	1A	7818	TO-220
+24	1A	7824	TO-220

Table 2. Common values of the 78-series of voltage regulators. The "Output Current" column lists the maximum current for a device mounted on a sufficiently sized heat sink. Usable current for the application described in the text is significantly less.

In most cases you will have to forgo any type of heat sink on the regulator if you choose to return the adapter to its original enclosure. Because of this, the maximum current available from a 78xx device in this application should be considered to be only about 25% to 50% of the device's maximum rated current. This is a price you pay for having a wall adapter with a well-regulated output voltage.

Don't blow a fuse!

Besides the regulator and extra caps, you might consider placing another item inside the power adapter's enclosure—a fuse. By fusing the input side of the regulator you will protect the regulator, as well as your project, from an overcurrent situation. Keep in mind, however, that this fuse will most likely be placed inside the adapter's enclosure, so to change the fuse you'll need to take the enclosure apart. This might not be an easy task.

The packaging design: Option #1

Packaging additional electronics into an existing power adapter is the key to a well-regulated supply that still looks professional. This is often an uphill battle, because manufacturers save money by minimizing the amount of wasted (i.e. available) space inside enclosures.

However, opening the power adapter without damaging the enclosure is generally the hardest part of any modification project. To open most adapters you'll need to use a sharp, thin knife or razor blade to cut along the seam between the face plate (the part with the terminals that plug into the outlet) and the rest of the enclosure (the square bowl). If you have yet to purchase

an adapter for modification, try to get one that is held together by screws. Keep in mind that the screws may not be visible; they may be covered by the manufacturer's label, requiring you to hunt for them by lightly running your fingernail over the label.

Packing a regulator and additional components into an enclosure is more of an art than a science, so there is no single recipe for success, but here are some suggestions: For the additional components you need to add into a circuit, try to place as many as possible directly on the adapter's printed circuit board (PCB). This form of mounting tends to increase the circuit's reliability.

In some cases, space permitting, you may be able to mount some components on the bottom of the PCB. This is especially true of smaller items, like filter caps.

Sometimes there are small metal plates mounted inside adapters for various reasons. You can often use this metal plate as a heat sink for the voltage regulator. This will increase the amount of current you can safely draw from the device. Make sure the plate is not electrically connected to other parts of the circuit.

Be sure to use heat-shrink tubing or tightly-wrapped tape around any component leads inside the enclosure. The leads may not be in danger of shorting together now, but components might shift around considerably the first time the unit is dropped onto a hard floor.

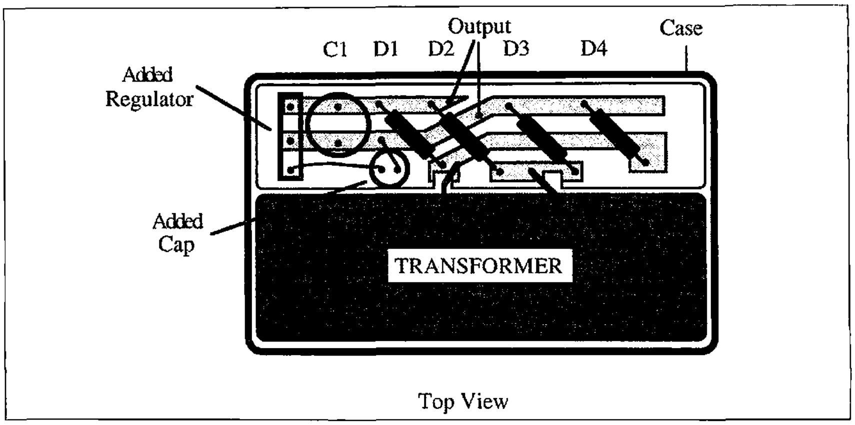


Fig. 5. One way to package a regulator and extra filter capacitors into a power adapter's enclosure.

Once you modify an adapter, run it for a while with the enclosure just taped together, not permanently sealed. Every 15 to 20 minutes of operation under full load, open the enclosure just to make certain you don't have the overheating problem mentioned above.

When you've finished your modifications and tests, reseal the enclosure using Super Glue™ or some other form of adhesive that works well on plastics.

Never modify an adapter rated for outdoor use, even if you plan to use it only indoors. It's too hard to reseal the enclosure in a way that is guaranteed to keep moisture out. Besides, if anyone else were to use the adapter they might see that it's labeled for outdoor applications, and use it as such.

The packaging design: Option #2

There is another packaging option if you are unable to modify an existing adapter case as described above—you can purchase a new case. Many electronics supply companies sell appropriate small enclosures. Some even sell dedicated "wall transformer enclosures." These are small cases with electrical terminals protruding through them that can plug into any standard 120V wall outlet. On the inside of the enclosure, you can generally solder to the terminals, making connection to this project's PC board easy.

If you are interested in this option, check your mail-order parts supplier for different enclosure designs and sizes before you begin the project. Most such cases are very inexpensive, and you might find them a bargain if you find it difficult to open an existing wall transformer case.

A Hamfest Computer Shopping Guide

You can computerize your ham shack for pennies on the dollar if you know how to shop the hamfests.

Alex Piechocki N3JSU
15 Locust Avenue
Towanda PA 18848

With hamfests and computerfests merging, they're getting to be great places to shop for computers. Today there is so much quality computing equipment available at such cheap prices that no one has the excuse not to have several computers in the shack. Indeed, today's hamfests often have more computer than ham equipment exhibitors.

IBM and compatibles with up to a 286 processor are available for under $100, complete and working. And that's with a color monitor, keyboard, disk drives, and up to a 20Mb hard drive. There is a tremendous supply of these machines, and little demand, so they're cheap. They make great packet stations, and will run satellite tracking software and do word processing; they're a great learning tool. Businesses sell their old computers for almost nothing to avoid hazardous waste disposal fees, as demanded by the EPA. Some of them are kaput, but many are just older, slower models which have had to be replaced.

What to look for

First, you want a monitor without a burned-in screen. Next, look at the cooling fan. If it is burned out or wadded up with filth, stay away! Keyboards should also be clean, right down to between the keys. A quick cleanup to cover up years of abuse won't usually get between the keys. Also, the case itself should be reasonably clean. Look for telltale signs of neglect from damp, unheated storage—like rust!

Open up the case and take a look inside. The motherboard (the largest printed circuit board you can see) should be clean, with no dirt buildup or corrosion. Check the battery. If it has leaked and corroded the surrounding chips and wire traces, you don't want the misery.

Check the cards plugged into the motherboard. The connectors should conform to the ISA (Industry Standard Architecture). That means you should have a 62-pin connector next to the back of the computer for connecting to the 8-bit bus.

> ***"The dealer has already made his profit, so any money he gets from the sale of these used drives is pure gravy."***

Next to the 62-pin connector should be a 36-pin connector. This connector, along with the 62-pin one, are used to attach cards to the 16-bit bus. Some manufacturers used custom connectors so their customers would have to buy *their* custom cards. Avoid these computers.

The AT&T-6300 has the 16-bit bus on the other side of the motherboard! IBM PS/2 models 50 and higher have a custom bus referred to as MCA, or microchannel. Parts for these guys are few and far between, and thus are expensive relative to standard ISA boards. The IBM PC Junior is in a class by itself, as are all Apples. The installed cards tell you a lot about what you are getting. Typically on these low-end machines you will have a minimum of three cards. One for the monitor, one for the disk drives, and one for input and output. If there are more, you might be getting a memory upgrade or a turbo processor. All of the chips have their date of manufacture on them, typically the year and week. This can indicate if some of the cards were added later or if everything is original.

Memory is important. The PC and XT computers, with the 8080/8086 microprocessors, could only handle 640K of memory. The 286 machines could address up to 16Mb. It is very easy to tell how much memory you have by checking the chips on the motherboard. Find a section of identical chips; the older machines had two banks of eight chips each of the 256K (total of 512K) and two banks of 64K chips (128K). After the manufacturers identification number there will be a 64, 256 or 1028, followed by a dash and then the speed that these chips can handle. All you need to do to the speed number is to add a zero and you have the speed in nanoseconds. For example, a -15 is 150 ns; a-7 is 70 ns. Speed is important because the faster the motherboard clock's speed, the faster the memory needs to be. If you are running an 8086 at a typical 4.77 MHz, your memory needs to be at least 200 ns. For a 50 MHz system the speed of the memory increases to 40 ns. You also will see that the 64K and 256K chips have 16 pins on them, the 1Mb (1024K) will have 18.

The 286 machines started to use memory called SIPs (Single In-line Package). This memory had the chips soldered on a small printed circuit board that had 30 small in-line pins. The chips used on these

memory boards can be easily removed with some solder wick and a small soldering iron. They can then be transformed into SIMMs (Single In-line Memory Module), which most new computers use today. A vendor might be selling motherboards for $3 each, untested with memory chips still installed; these boards are worth buying just for the memory! I once bought 486 motherboards for $10 each just for the parts. On each board was 256K in cache memory in sockets, which made it easy to remove them. Cache memory, and video memory, are different animals than regular computer memory.

The computer's main memory is referred to a DRAM, dynamic random access. This memory is nothing more than transistor and capacitor pairs. They are dynamic in the sense that the capacitor always wants to discharge, so the computer has to ensure they get charged back up millions of times per second. SRAM (static RAM) or VRAM (video RAM) or SCRAM (static cache RAM) are all the same idea. They are set to digital ones and zeros and stay at this value until externally changed. They are very fast, largely due to more transistors inside for the megabytes they contain, and more expensive, hence you will not see many computers using these for main memory.

Software and documentation are an important part of the deal. "No software" can mean having a computer that can't do anything. All computers have a small software program built into them. The program executes whenever you turn on your computer. It is referred to as the POST (Power On Self Test). This self diagnostic will indicate any number of problems, from a stuck key on the keyboard to bad memory. But after this the most important software to have is the DOS (Disk Operating System). Fortunately, if your computer is really bare bones, down the isle is probably someone who will sell you an obsolete copy for a couple of dollars. PC DOS or MS DOS are the same software—one was written for IBM, and the other was written for IBM compatibles. Both were written by Microsoft. The program has undergone several revisions, with the current one up to version 6.2. The older computers cannot even use the newest version, so the copy of version 3.2 for one or two dollars isn't too bad a deal. Version 5.0, which is very close to the latest and greatest for newer machines, can be had for $5 a copy! Unfortunately, to make good use of the version 5.0, you need a lot of memory and at least a 386 processor.

Documentation is helpful when it comes to setting some of the motherboard's jumpers. If you are planning on doing a lot of tinkering and would like to modify the motherboard, there is hope. Some of the larger libraries have, in their technical section, a book copy or even a CD-ROM of *The Micro House Encyclopedia of Main Boards*. This reference book details all of the switches and jumpers on most of the motherboards you will find.

Upgrades and parts for your PC

Because used computers bring such low prices, many dealers run chop-shop operations. They disassemble hundreds of PCs and bring the parts to flea markets in hopes of making a larger profit. You can get an idea of pricing by checking the classifieds in some of the computer magazines.

The first monitors were black and white (or orange or green) and used an internal MDA (Monochrome Display Adapter) card. They were only good for text. The next monitors were called CGAs, after the internal plug-in card (Color Graphics Adapter). This improved somewhat with the next generation called EGA (Enhanced). the color monitors truly made an important transition when they went to VGA (Video Graphic Array). Hospitals and some industries keep up on the latest technologies; as soon as Super VGA became available, the installed VGA monitors became obsolete. Also, many companies lease computers, and at the end of the lease there is a lot of outdated equipment to be dumped. Refurbished VGA monitors can be bought for around $100 and come in several sizes. I've seen a 12" go for under $75, and the 15" go for $130. Try to purchase brands that you will be able to repair. Schematics on some monitors are harder than others to find. Some schematics are included with the deal, while others might cost you over $50! With any monitor you need a compatible interface card to run it. CGA and EGA cards can be bought for under $15. VGAs, on the other hand, start where the less expensive cards leave off. There's a lot of snob appeal in these cards, so brand names like Orchid and Cirrus tend to increase the asking price as well as the

quality of documentation and the quantity of memory. Since VGA cards can still be bought new for under $50, it pays to keep up with the latest ads. The latest and the greatest is to be able to plug your video card into the high-speed computer bus. This only exists on 486 and newer computers. It is referred to as the Local Bus, VESA local bus, and PCI bus. This is what you eventually would want to graduate to if you have the latest fast-action video games to play. If you like a lot of color resolution, select a video card with at least 1 megabyte of video RAM. The one really neat thing about all of these cards is that they are all downward compatible; in other words, the software that runs on your MDA system will display correctly on CGA, EGA and VGA systems!

Disk drives come in several flavors. The floppy drive on the PC was only capable of storing 360K worth of data. The XT had a version with two floppies; one was a 360K and the other a 1.2Mb. The crazy thing about these was that the magnetic media on the disks were different for each of the disks. That made for easy mistakes in using them in the wrong drive. Therefore you could end up with read or write errors, even though the disk drive was working fine. These large 5.25" drives gave way to the 3.5" 720Ks, which are basically useless today. The standard 3.5", which is on all new machines, provides 1.44Mb. The small 360K drives are available new for $1, so you don't repair these, you just throw them out whenever they fail! The large 1.2Mbs are available for $20 used, and the small 1.44Mbs you can buy for under $30. Most floppy drives plug in via a flat cable to the same driver card as the hard drive. The number one wire is painted red, so make sure it plugs into the number one pin on the drive. If you are running only one drive, the end of the line plug is used. It is the one with the twisted piece of cable next to the connector. This "end" piece is the A drive when you have two floppy drives installed.

Hard drives are a lot of fun. There are many wacky ones out there waiting for you! The earlier ones included on the PC were of the MFM (Modified Frequency Modulation) type. Following these were the RLL and the ESDI, both improvements to the MFM technique. These drives require special formatting to use so removing an MFM drive from a PC and installing it into an AT requires a complete new format! We're talking machine code here, which is not a pleasant task for a novice. Stay away from these old outdated formats unless the drive is exactly the same as the one you have and you've grown attached to its quirks.

The latest and greatest today is SCSI (Small Computer System Interface) and IDE (Integrated Disk Electronics). They both are about the same speed. One sends its data in parallel and can support up to seven devices (SCSI), while the other (IDE) sends its data in serial and can support two devices with the same interface card. I recommend going with IDEs; they install more easily than MFMs and RLLs. They plug into the IDE interface card, which is also plentiful and cheap—typically one or two dollars. New ones can be bought for under $20. IDE drives of 40Mb can be bought for $20 from dealers who upgrade computers. The dealer has already made his profit, so any money he gets from the sale of these used drives is pure gravy. Hard drives are hermetically sealed and designed for 50,000 or more hours of use before failure; however, shock, vibration and heat can lower that. But there should still be many hours left for you to play with.

"A vendor might be selling motherboards for $3 each, untested, with memory chips still installed; these boards are worth buying just for the memory!"

Accessories such as CD ROMs, sound cards and such are available as people upgrade. Single-speed CD ROMs with 8-bit plug-in cards are available new for $25. There's no demand for these when the state of the art is already selling CD ROMs at 8X speeds. People are conditioned to think that single-spin is too slow. Believe me—a single-spin CD player will still locate that callsign for you faster than using the book, and you have the added benefit of playing your favorite musical CDs too. Sound cards are available as people upgrade to the latest and greatest in multiple voice polyphony. After years of listening to single sideband, an 8-bit sound card will sound heavenly. But don't stop here—16 bits is the standard, and again, if you shop around you can find these at bargain basement prices.

Building your own computer

Over $10 billion in hardware is out there getting obsolete. Some of it will find its way to your local hamfests for pennies on the dollar. What a temptation to build a system that is really unique, teaches you a new skill, and does something useful for you around the house or shack.

Remember, with computers running in the RF range you need good grounding. If your enclosure has sturdy grounding fingers, along with liberal amounts of stainless steel wool on the edges, then when you transmit your RF will not get into the computer and confuse it or shut it down. This will also keep the computer from messing up your receivers.

The best way to build your own is to start out with a cheap system. The 286 computers came with good power supplies. Be very wary of the high volume computers such as IBM, Dell, Compaq, and AT&T, since only large companies can afford to build nonstandard, one-of-a-kind parts. Almost all of the other computers use generic parts.

Most power supplies are identical. They are all switching supplies, and even the connectors to the motherboard are the same. Just remember to put the four black ground wires in the middle if your supply has two plugs.

The one thing to pay attention to is watts. The very early computers were small; only 85 watts. Try for something up in the 250-watt or more range. Accessories take lots of power. Once you have a computer with a good power supply, case and disk drives, all you need is to replace the motherboard and you can say you built your own. Motherboards are relatively inexpensive, even if you buy a new one. New motherboards are tested and warrantied, and go for $50 or less for a 486 type. You can buy these boards minus the processor chip, which is the big money. Look around at the 'fests for processors. Since many people upgrade, you can find 486-SX 25 MHz processors for

$20 to $30. That is the bargain way to start. You can always upgrade with the faster DX-2s, 3s and 4s later.

First, you should be aware of how these processor chips are different. All Intel 486 chips are made the same. It is in the testing that they are given their labels. The SX label is for 486s that had defective math coprocessors, which are for floating point math. The only programs that use it are engineering work stations, computer assisted design (CAD), and some spreadsheet programs. Most games don't use this processor since they don't need the precision or the resulting slower execution speed. To upgrade the SX with a math coprocessor you have to buy a 487 chip. This chip is a DX chip with an extra pin on it to disable the SX chip (pretty sneaky, eh?). The 486s are warmed up and run at a high clock speed at the factory; the ones that pass error-free get the highest ratings. The ones that fail are re-tested at a slower speed. Thus you have your DX-50 MHz, DX-33 MHz, DX-25 MHz, etc. The same holds for SX too.

Some motherboards let you change their clock speed with little jumpers, some with software, and some need to have the on-board clock chip replaced. Make sure your motherboard can run at the speed of your chip. If you only run your computer for a short time, or slap a big heat sink and fan on the chip, you can juice up the clock speed and run faster than the numbers painted on the chip. I've run my 25 MHz chips at 33 MHz with no errors. Just put your finger on the chip under load ... if it feels hot you will shorten its life, but if it is cool to the touch you shouldn't have any problems. The DX/2 series plug into the same socket as the other 486s. It is worth it to pay a few dollars extra for a ZIF (Zero Insertion Force) socket. Then you can change your processor with no effort in seconds. Just remember, there is an alignment dot that needs to be followed. Sometimes it is a squared off corner, so follow it to ensure you put the processor in the right way.

The DX/2 and /3 and /4 all have frequency doubling, tripling, or quadrupling circuits in them. The reason it makes your system faster is that when an instruction is sent to the processor, the processor can take many clock cycles to decode and act on the command. But it only takes one cycle to bring in instructions from the motherboard. So, to set the frequency on the motherboard for these chips, divide the chip frequency by its multiplying number. The DX/4-100 is run at 25 MHz; the DX/2-66 at 33 MHz. After everything is put together it is amazing how these systems start right up.

Digital electronics does not have all of the tweaking that analog does, but there will be some small details to attend to before you will be on your way. All motherboards have some form of setup. The earlier boards used jumpers. This evolved to software disks, to the point now where the setup is part of the system's BIOS (Basic Input Output System). Remember those POST error signals (beeps sort of like Morse code, or an on-screen message to tell you your error)?

When you start up you have the opportunity to go into the computer's CMOS setup. This is a couple of chips that use very little power and have the on-board battery feeding them when you turn off the computer. When you go into the setup you tell the computer what you have attached to it. You type in the size disk drives that you installed, the amount of memory on the board, what functions you want the motherboard to use, such as clock speed, cache controller, etc. You can usually wing it, but having some documentation on what and how sure make you feel more comfortable as you are typing.

Sometimes your system may appear to be dead on startup. The boards you installed might be set to the same address or interrupt (IRQ). Simply remove all of the cards, with the exception of the video one, and gradually start putting them back until you find the conflict. This type of problem doesn't usually happen until you put the CD-ROM, sound card, mouse driver card, game port, and fax modem cards in. There is a good chance that the computer is trying to talk to two or more cards at once. Computers may be fast, but they still need to communicate to the input and output one at a time.

This has been a whirlwind tour of computers, by no means complete. Even if you are planning to purchase new, going to the dealer with some basic knowledge of computers and the prices of the various components can help you drive a better bargain. I hope I will be seeing you at the flea markets, having as much fun as I do, recycling computers and keeping hazardous waste out of our landfills.

A Retiree's HF Mobile Installation

This style of hamming ain't exactly hard to take.

Bert Simon K2FZ
2110 NW 45th Ave.
Coconut Creek FL 33066

After having lived on boats for 15 years, the concept of a mobile HF installation was so embedded in my failing brain that when the time came to give up boats and become a landlubber, I knew that the dreaded ham virus would force me to acquire a good HF mobile station. Selling my boat put me in a position to choose, within reason (my wife said it was OK), the vehicle, the radio and the antenna.

The vehicle

I envisioned a vehicle that would contain a small desk for writing, reading and hamming. A comfortable place to recline would be kind of nice, for resting the eyes when the need arose (which happens rather frequently as one nears the QCWA second cluster category). I chose a "high-top conversion" type van which came complete with four captain's chairs and a bench seat that folds down to become a bed at the flip of a switch. A sturdy desk was installed behind the driver's position and *voila!* A very comfortable vehicle where every day can be a "Field Day." Three additional batteries, of the gel cell persuasion, were installed, along with battery safety/disconnect circuit breakers. A digital voltmeter is being constructed to provide close voltage measurements, important in making a battery's life long and prosperous. Additionally, a through-the-ceiling fan was installed and is generally in operation when the van is parked. I haven't found it necessary to charge the batteries after three hours of hamming and ventilating, but then again, so far I haven't operated more than three hours at a stretch.

"The marine channels might come in handy if I'm ever marooned by a rising tide."

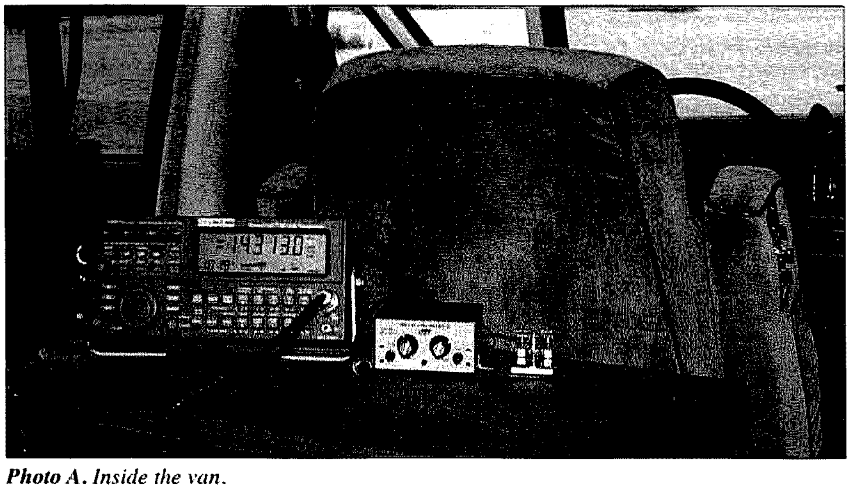


Photo A. Inside the van.

The radio

The latest breakthrough in HF communications appears to be DSP (digital signal processing) in which, due to the wonders of science, the gershmeckda signals go through an amorphous transition into a digital conglomeration completely alien to humans. It is then magically transformed back into supposedly intelligible signals. Considering that this radio might be my last big ham purchase before being recalled from this planet, I decided I might be remiss if I didn't become a DSPer. Other considerations involved money as well as the weight of the radio (some of the very sophisticated radios weigh in at 30-plus pounds and get into the three-plus kilobuck category). I decided it would be best to keep the "radio footprint" to a minimum and so decided on a remotely-operated rig.

The radio which met my criteria was the SG 2000 with Powertalk head (DSP, that is), made by SGC of Bellevue, Washington. The price was under three kilobucks and the radio weighed 12 pounds, which didn't make any difference since the remote head, which was the device to be table-mounted, was only about two pounds. This radio has

nice features, such as over 600 marine channels programmed into its memory. I figured this might come in handy if I'm ever marooned by a rising tide—I can always call the Coast Guard. The radio also comes with over 60 ham frequencies programmed, which mainly represents the band edges as well as other convenient frequencies used for ham mobile/marine operations. Additionally, 60 other frequencies may be programmed in according to individual requirements. But heed these words of caution: This radio is not for every ham and there are those who may find some of the operating features are less than ideal for typical amateur operation—if one allows four seconds to go by without using the main frequency dial it is then necessary to press the "FREQ" button, sometimes more than twice. When this button is pressed, the radio beeps to announce that the button has been pressed and the tuning knob is now operational; it's not exactly a "contest" radio. As for CW, I have found it unusable due to the delay of the AGC response. I have discussed this problem with SGC and am awaiting their recommendations. For now, I am able to use the radio on CW by providing an MFJ keyer with an audio tone, and then feeding the tone signal plus an additional pair of leads to a big old-fashioned switch. Both sets of leads are wired to a separate microphone connector. The other item which takes a bit of getting used to is the CW DSP operation. The apparent bandwidth in this mode is very sharp and in order to be able to switch the DSPer from the broad mode to the sharp mode it is important to receive the CW tone at approximately 1000 cps. I find that I'm not always able to select the tone accurately enough to fall within the passband of the filter. Again, it's not exactly a contest radio.

There are approximately 30 push-button functions to this radio and the DSP version has an additional eight push-buttons plus some added knobs. I admit it would take a better man than I to operate this radio and still survive bebopping down the road at 65 miles per hour. In fact, in my degenerative condition I find it somewhat exasperating to locate the necessary buttons (let alone execute them) before the telltale sound of the beeper announces that the four-second period is up and I must start over again. (Perhaps a neuron transducer can be added to activate my sole operating brain neuron, which might enable it to move fast enough to avoid the dreaded four-second announcement.)

"If I didn't require a stool to stand on, I could probably install the antenna in less than a minute."

Now, with all my criticism regarding the SGC 2000, one might think that I don't like it. *Au contraire, mon ami.* The radio, in spite of its faults, does have its charm, although I do believe that it, along with SGC's QMS mobile antenna and its "20 dB advantage," would be best suited for a non-technical/non-ham paramilitary-type operator.

The antenna

I have found Don Johnson's book on HF mobile installations to be a wealth of information. Additionally, valuable mobile antenna comparisons are contained in *QST* and *Worldradio* issues. The "HF Mobile Shoot-Out" described by *Worldradio* compares the relative radiation of 17 HF antennas ranging from those having center-loading coils with and without top hats to the SGC-QMS (20 dB advantage) bottom-loaded antenna. The high Q center-loaded type won hands down, with those having top hat devices showing a 2 or 3 dB advantage over the less grotesque center loaders. The worst antenna was the one which was advertised as "the 20 dB advantage." It measured about 10 dB *less* than the typical center-loader. Quoting Gilbert and Sullivan: "Things are seldom as they seem." My advice: Beware of extravagant claims.

I had decided that an antenna that could be remotely tuned to continuously cover the entire 80 through 10 meter spectrum and have a high Q center-loaded coil would be my choice. I investigated two of the several companies producing such antennas: T.J. Antenna Co. of Hermiston, Oregon, and High

tenna Co. of Hermiston, Oregon, and High Sierra Antennas of Nevada City, California. They appeared to have similar products, all based on the Don Johnson design. I chose High Sierra because they had available a type of mount which allowed the antenna to be readily removed. In fact, I can remove and/or install the antenna in less than three minutes, but if I were as tall as a basketball player and didn't require a stool to stand on, I probably could do it in less than a minute.

High Sierra makes several types of mounts and they can also manufacture just about any mount to suit individual requirements. Their mounts are of heavy-gauge steel construction and are attractively painted black, which closely matches the type of rectangular aluminum extrusions used in condo "screened-in constructions." I decided to use High Sierra's mount and join it to a two- by three-inch aluminum extrusion (readily available at large hardware stores). I joined the aluminum extrusion and the "Universal Mount" from High Sierra with #14 SS self-tapping screws and star washers which provided rigidity and good electrical bonding.

I was able to mount the antenna without drilling any holes in the van by using U-bolts to fasten the aluminum structure to the spare tire supports. I recommend using proper HF practice and making certain that there are good grounds between the supporting structure and the vehicle, but then again, just follow Don Johnson's advice and you'll have a good installation. Truthfully, I am not absolutely certain how my signal would be affected without the proper grounds, but I'll put it in the same category as the test for pearls: "Place the pearl in a container of vinegar and if it dissolves it was real." The only holes I drilled in the van were the ones to provide the DC voltage and the coax feed to the antenna; I thought it looked better than having wires dangling in the wind whenever the antenna was not in place.

One other advantage of this radio and antenna combination is its ability to tune in all kinds of other HF activities—SWL broadcasts, marine stuff, etc. Having a continuously tunable high Q antenna covering all the frequencies from 80 through 10 meters really makes for excellent reception.

The end result

I am thrilled with the entire mobile operation. I compare it to my base station, which is an ICOM 735 using an ICOM AH-2 remotely-operated antenna tuner. This particular setup is my condo HF station and employs about 17 feet of wire as the antenna plus about five radials, installed under the carpet of the ham shack, which range from five to 10 feet—not a very good installation but at least it's hidden from the eyes of the condo commandos. I find that I am able to receive more signals and more DX from my mobile when parked right next to the condo, as compared to the condo base station. A good indication of the mobile's performance is the amount of returns I get from calls made; it's much better than that of my base station. The antenna tuning is remotely controlled by an up/down switch conveniently installed near the radio and the built-in SWR indication of the SG 2000 works well, although it does require the pressing of two buttons to activate the SWR function. The "SHFT FUNC" button must be pressed before you can press the "FWD-SWR" button. I wouldn't recommend tuning the antenna while driving—however, the usable bandwidth on 20 meters is quite adequate, about 200 kHz without requiring retuning. I attribute the success of my mobile installation mainly to the quality of the High Sierra Antenna and the sage advice in Don Johnson's book. I must also give credit to SGC because I have frequently been told that I have excellent audio quality.

Life is good. ■

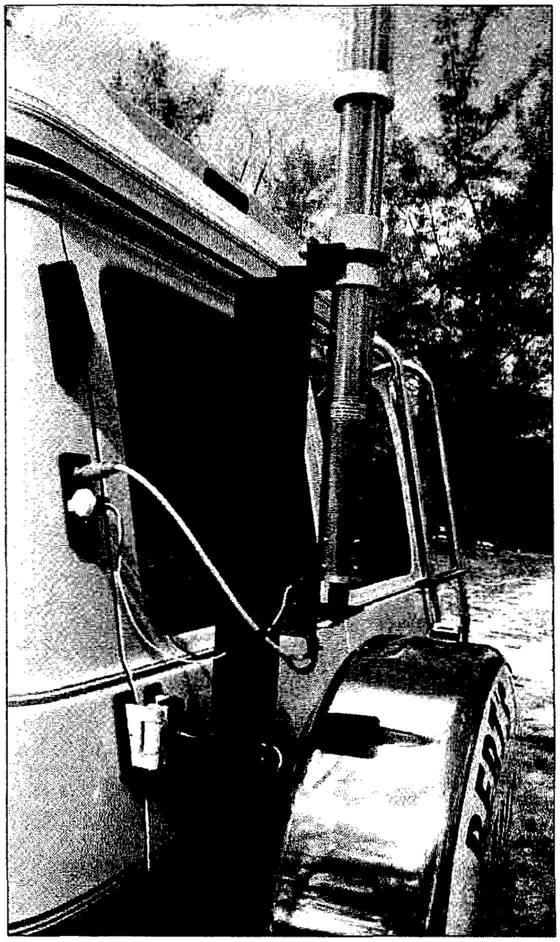


Photo B. K2FZ's van, with the antenna attached.

NEVER SAY DIE
Continued from page 59

nation, under God" stuff. Hmm, now that I think about it, that "Under God" part got added later. Our pledge of allegiance when I went to school never mentioned any deity.

For that matter, the pledge never meant anything either. If the United States was viewed as good we'd support it. Considering the problems we face today, it is getting more and more difficult to feel anything strong about our country. The main thing it has going for it is that, as terrible as things are, they seem to be worse most other places. But that's not something I'd willingly lay my life down for. If you don't chew gum, spit on the street, spray-paint cars, or pee in elevators, Singapore has a lot going for it.

During WWII I had no problem in volunteering for the most dangerous duty there was because I really didn't care much whether I lived or died. Recent research has shown, as I've mentioned, that this was the result of the childhood beatings by my father. This is one of the major causes for teen suicides. Luckily I underwent some brain repairs when I was 28 which got rid of all that crud and changed my life.

Please, let's stop zealots from trying to use the government (and our federal judges) to further their religious goals. I'd also like to get the government out of social engineering too. Not one program has worked, but that's not enough to stop the under-informed from pushing to spend more of our money for their pet projects.

Oxygen

The largest organ in our bodies is our lungs, and they're there to bring oxygen into our systems. We burn oxygen for fuel. Plus, more oxygen in our blood helps kill off microbes and viruses. Now do you suppose that there's any connection between the dropping percentage of oxygen in our air and the recent increase in all kinds of illnesses? It might even tie in with the increase in gutlessness and lack of creativity shown by our younger generation since oxygen is critical to the brain's operation.

How much oxygen have we lost so far? A couple hundred years ago our air had 38% oxygen. In the 1950s it was down to 21%, and now it's down to just over 19%! Worse, in the cities it's as low as 9%, due to the extensive heating of buildings by burning fossil fuels, the thousands of cars and trucks, and even millions of people breathing.

One of the benefits of jogging is that it forces us to breathe more heavily and bring in more oxygen. Dr. Douglass, of *Second Opinion*, has a great book out on how to prevent aging. In it he recommends breathing pure oxygen every day while exercising as a way to reverse the aging process. Adding
Continued on page 82

NEVER SAY DIE

Continued from page 81

oxygen to our bodies seems to help beef up our immune systems, which in turn can help reverse arthritis, cancers, and other annoying breakdowns of the body.

It seems to me that if you can even remember every now and then to hyperventilate, that's going to being more oxygen into your system. But I know how difficult it is to remember to breathe.

When we get tense our tendency is to hold our breath, making it even worse. There are few headaches that can't be cleared up by hyperventilating—getting more oxygen into your system, where it first goes to your brain, and then to the rest of your body. The brain uses a surprising amount of oxygen, so when we cut down the brain is one of the first parts to malfunction.

The decreasing oxygen percentage in the air means a higher percentage of nitrogen (and a much higher percentage of CO_2), leading to an increase in nitrogen narcosis, the "rapture of the deep" it's called when you're diving. It's a gradual loss of reality, but one which is not noticeable by the individual involved. Maybe you've noticed a lot of that going around.

If you've read anything about breathing you know that just as we gradually lose the flexibility of our eyes from focusing them at one distance or direction so much of the time—reading, computering, TV watching—we also lose a great deal of our lungs' capacity to bring oxygen into our bodies by shallow breathing. Every so often exhale completely and then suck in as much air as you can into your lungs and hold it for a few seconds. Then completely exhale again. Use more of your lung capacity whenever you think of it. And hyperventilate to make up for all that oxygen that's no longer in your air.

I see where in Beijing there is a flourishing business in selling oxygen. They have booths where you can breathe 50% oxygen for $6 an hour. That's something which could do well in our more polluted cities such as L.A., Denver, and New York.

The Value of College

A recently released study showed that the $40,000 investment for a college education results, on the average, in an increase in lifetime earnings of $300,000. Hey, that's almost a 10-times gain on your investment! No wonder parents are so anxious to get their kids into college. Yeah, except for one little tiny thing. If you take that same $40,000 and invest it in something safe that returns 6% you'll end up with $550,000.

Big corporations put a good deal of stock in your college degree when they're hiring, but few small companies give a hoot. They want to know what you can do for them, not where you went to school. And working for a large company is one way to pretty well assure that you are never going to make any serious money. I keep mentioning the *Inc.* magazine survey which showed that virtually all of our more successful entrepreneurs either skipped college entirely or dropped out in frustration after a year or two. College does help the unmotivated to make more in dead end jobs, but seems to be a waste of time and money for anyone with the determination to succeed. So much for the election oratory about how everyone should be able to go to college. For what? Just to keep them out of the labor market for four more years at public expense and further dumb them down and demotivate them?

I tried hiring RPI graduates for my company and was appalled at their lack of skills or even any interest in acquiring skills. I went to the university and interviewed graduates, looking for the most promising. Most were incredible duds and not worth even trying. The few I ended up giving a try were unmotivatable.

When I started *73* I used to hire college dropout hams and teach them the publishing business, and they were eager to learn. Some have gone on to excellent careers as a result, doing very well for themselves.

Just as anyone with the right help can learn to read and write in a hundred hours (according to the top prize-winning New York State and New York City teacher John Gatto), anything of value one can learn from going to college can be learned in a tiny fraction of the time by reading books by the world's top experts (who beat the heck out of the professors most colleges provide). Our colleges, like our grammar and high schools, are a mess.

Schools

Just in case your only reading matter is the ham rags and your TV set is broken, I'm going to rub

your nose in what a mess you've let our schools get in. It's bad enough that you're screwing up your life with that garbage you've been eating and sewage you've been drinking, but in addition to teaching your children to eat and drink the same destructive stuff, you've also allowed our school system to disintegrate so they are being mentally poisoned and stunted. Hey, don't look around for someone else to blame. And none of this gee, what can little me do about big problems like that?

Now let's look at some facts of what you've sheepily let happen, and most of it has been done with the money our beloved government has taken out of your pocket and spent for you. You can't name one single job the government is doing that can't be done far better and at less than half the cost.

The government loans for students have helped zoom college costs. $24 billion today, and headed for $36 billion in five years. All not just a total waste, but a poisoning of the educational well. I won't repeat again my simple plan which would completely eliminate college tuition and at the same time enormously improve what students are learning, making it infinitely more practical and useful in the *real* world.

In the past 15 years, while the Consumer Price Index has risen 74%, college tuition has risen an average of 234%. In 1979 the cost of a college education (already inflated) equaled 21% of the average family's income. It's now 39%. Tenured professors earn an average of $60,000 annually for 18 hours a week of work, 30 weeks a year.

From 1975 to 1985, while student enrollment grew 10%, the non-teaching staff (like deans) grew by 60%. And in the last 30 years the academic year shrank from 191 days to 156.

At a majority of the top 50 colleges listed in *US News and World Report* students can graduate without taking a single course in math, science, English, history or literature. The Hudson Institute reports that American schools are now awarding more degrees in home economics than math and more in protective services than in all of the physical sciences.

A federal study showed that 56.3% of the graduates of four-year colleges couldn't calculate the change they'd get back from $3 after buying a 60¢ bowl of soup and a $1.95 sandwich. Parents are spending fortunes on four years of expensive baby-sitting, and we're all forced by law to support this mess. Or else go to prison.

American students rank #1 in the world in how good they feel about their math skills, but a 1992 international study by the Educational Testing Service showed us ranking last in math achievement (well behind Slovenia). In 1972 28% of college-bound seniors had an A or B high school average. By 1993, 83% had an A or B average, while at the same time their SAT scores were plummeting. Now the educational establishment, to cover its dirty tracks, is planning to "re-norm" the SATs, since they've gone down permanently.

The students with the lowest SAT scores become education majors. Students who earn education degrees have lower scores on all the accepted tests than any other major than social work. They don't read, and few can write a coherent letter. On the average, our teachers read one book a year, and that's a fiction book.

More money isn't going to cure this mess. Paying dumbed-down teachers more isn't going to make them better. Creating even more administrative layers isn't going to help our kids.

Why did you have a kid anyway? Your kids are probably the *only* mark you're going to leave on the world to record your having been here. Why are you teaching them to eat garbage and drink sewage? Why are you putting them into our cesspool public schools?

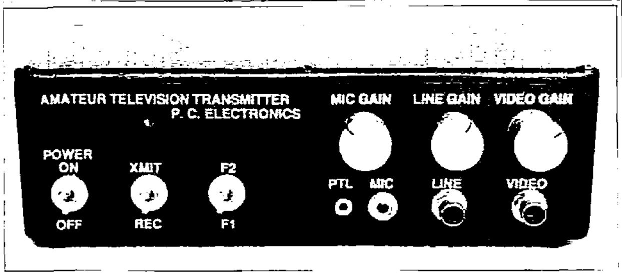
Maybe you've read that parochial schools cost about a third as much as our public schools per student, and teach them far more. Probably not.

So what can you do about this mess? Start at the heart of it: your government. Get out there and vote, making sure that you Never Re-elect Anyone (NRA). And get your family and friends out there to do likewise. Let's flush that Congressional toilet we've allowed to stop up and stink. Step two is to get some ham friends to run for your state legislature and re-elect the heck out of them. Let's infiltrate the system and start hacking back

Continued on page 85

New Products

Number 84 on your Feedback card



More Fun Than Rabbits

If you've played with the FCC part 15 "rabbits" you'll find that this new ATV transmitter from PC Electronics will allow much greater scope and reliability. The new TX33-1b 33cm band (902-928 MHz) 1 watt transmitter is sturdy, accepts video from most camcorders, cameras or VCRs, and has an 11-mile snow-free line of sight DX. A video monitor jack lets you set up focus and lighting before you transmit, then shows you your video so you can fine-tune.

It's compact, rugged, and surprisingly inexpensive, at $329 (including shipping in the contiguous USA). If you're a licensed ham, contact PC Electronics by phone, snailmail or E-mail for details at 2522 Paxson Ln., Arcadia CA 91007. Phone (818) 447-4565; E-mail tomsmb@aol.com.

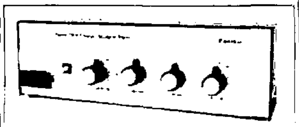
I'll Take One of Each...

The new Contact East catalog supplement is 48 gorgeous full-color pages of test equipment, tools and supplies for engineers, hobbyists, managers and technicians. All the brands you trust, all products fully guaranteed, and Contact East promises same-day shipping on orders placed by 4PM. To get your free copy, call (508) 682-2000; FAX (508) 688-7829; write Contact East, Inc., 335 Willow Street, North Andover MA 01845.

Alinco Responds to Ham Needs

The new DX-70TH was created for hams who've enjoyed the features of Alinco's popular line of amateur equipment, but have wanted more. Well, here's more! The new model maintains all the features of the DX-70T mobile/portable/base unit but increases the output on 6 meters to 100 watts (the DX-70T has a 6 meter output of 10 watts).

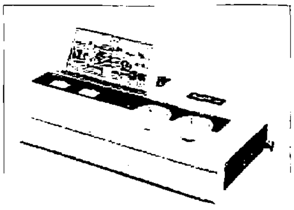
Priced at $1,074, the DX-70TH can be used as an all-mode (SSB, CW, FM, AM, and Data) radio in mobile/base/portable environments. A mobile mounting bracket is included, and many other accessories are available. See your dealer for more information or write Alinco, 438 Amapola Ave., Ste. 130, Torrance CA 90501. Phone (310) 618-8616 or FAX (310) 618-8758.



Field Strength Meter

Palomar Engineers announces a new field strength meter, Model PFS-1, for serious antenna work. It features a detector linear over nearly a 30 dB range, an accurate step attenuator with 30 dB range, a 25 dB RF amplifier, high Q tuned circuits to suppress out-of-band local signals and a panel meter readable to .1 dB.

The meter covers 1.8 to 150 MHz and is powered by 9- or 12-volt batteries. Antenna connection is an SO-239 jack on the rear of the aluminum cabinet. All this, and the PFS-1 is priced at only $195! For further information, contact Palomar Engineers, P.O. Box 462222, Escondido CA 92046; Phone (619) 747-3343; FAX (619) 747-3346; E-mail 75353.2175@compuserve.com.

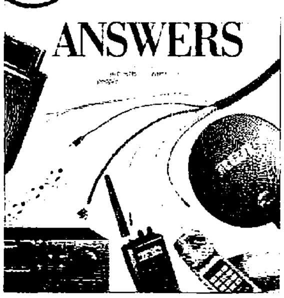


In Synch

Need to synchronize your station to absolute time? TrueTime has an affordable solution: The TimeLink 3 (TL-3) is a precision real-time clock that receives three channels of WWV radio-transmitted time signals simultaneously. Transmissions are synchronized to the National Institute of Standards and Technology Atomic Time Standard. The TL-3 outputs time on a Display, RS-232 I/O port, IRIG B serial time code, audio speaker and a 1 PPS. Computer software drivers are available for DOS, Windows, Windows NT and Novell Netware—and all this, including the antenna, is only $549! For more information contact: TrueTime, Inc., 2835 Duke Court, Santa Rosa CA 95404. Phone (707) 528-1230; FAX (707) 527-6640.

New Multiband Dipole Antenna

Dynamic Electronics Inc. announces their new multiband antenna for HF and VHF. The DP-1 covers 80, 75, 40, 30, 20, 17, 15, 12, 11, 10, 6, and 2 meters. It's 125 feet long and has a maximum width of 2 feet. This 8-dipole element trapless antenna has wide bandwidth on each band and can handle maximum power, and it is $129 plus $6 shipping and handling (US and Canada). Also available is the DP-2, which covers 40, 30, 20, 17, 15, 12, 11, 10, 6, and 2 meters. The DP-2 is only 65 feet long (maximum width 2 feet), and is priced at $110 plus shipping and handling. For more information, contact Dynamic Electronics, Inc., P.O. Box 896, Hartselle AL 35640; (205) 773-2758; FAX (205) 773-7295 or check it out at HTTP://www.hsv.tis.net/~dei.



Need Answers?

Here you go! The 1997 edition of *Answers*, the new RadioShack™ catalog, is available now. It's 280 pages of what you'll find at more than 6,800 dealers across the country—plus the hundreds of products available through RadioShack Unlimited, a special order program that gives customers access to more than 100,000 unique and hard-to-find personal electronics products, parts and components. *Answers* is an easy-to-read reference tool that helps take the mystery out of electronics, for only $2.95.

It's Free!

If you've been looking for a club involving radio here's a new guidebook that may be just what you need, especially if your QTH is in the Southeastern United States. The *Radio Hobby Clubs Pocket Guide* lists more than 50 clubs, including ham radio clubs, scanner clubs, CB clubs, and a radio-related computer bulletin board. Radio hobbyists will find club addresses, contact phone numbers, meeting places and times, and radio frequencies for the West Central Florida area.

Anyone interested in radio can get this handy little (5-1/2 x 4-1/4 inches) guide by sending name, address, and two first class stamps to: RADIO CLUB GUIDE, P.O. Box 103, Largo FL 33779-0103.

Handbook on CD-ROM

The ARRL Handbook CD ($49.95) will simplify searching for information in this PC version (Windows/DOS) of their massive yearly handbook. It includes sounds bites to illustrate various modes and activities. For some uses the paper edition ($38) is better, but with the CD edition you get many active programs for calculating antennas, feedlines, etc.

Get both.

QST on CD!

The back issues of *QST* are now available on CD, from 1970 through 1994. Each four-year group costs $39.95, putting 24 years of the magazines into one small CD wallet for you. Yes, they're working on ROMing the earlier issues. What a great way to search for articles! This is like an encyclopedia of amateur radio. Yes, the columns are there too.

More Antennas

The ARRL has announced Volume 5 of their Antenna Compendium series. It includes 41 articles and a disk (IBM format) with data for use with antenna plotting and modeling programs. $20.

Never say die

Continued from page 83

the forest of rotten laws we've allowed Congress to use to steal our money and spend it on stuff that is ruining what could be one heck of a country.

If you just nod and sit there, nothing is going to change for the better, but we know from history that it is going to keep getting worse, and our kids are so poorly educated and stripped of creativity and guts by our schools that they're going to accept whatever comes along, the same way you have.

Sermon over. Oh yes, thanks to Walter Williams and Don Feder for the statistics I stole from their columns.

Magnetic Healing?

I've read a good deal about the power of magnets to help the body heal. I've even reviewed a couple of books on the subject, and I have a good friend I met at the Global Sciences Conference in Tampa earlier this year who is an expert on the subject. So I wasn't completely surprised when I got a letter from a reader who was active in the early linear accelerator days.

He explained that the researchers for General Atomic, working on the linear accelerator for Lawrence Livermore in San Francisco, were surprised when their magnetic doughnut-shaped coils collapsed the copper tubes the coils were wound around when the capacitors were discharged into the coils. They didn't know that nonmagnetic materials such as copper, brass and aluminum could be formed by a high energy impulse magnetic wave. Once they discovered this they sold units to several companies for forming parts.

In the early days of testing the equipment one technician didn't want to bother setting up a special jig, so he just held the part to be formed in his hand and let loose the magnetic blast. His hand got a severe burn that should have taken at least six months to heal. A few days later it was healed. They tried to interest people in the medical field, but got nowhere.

One of their people got his ankle shattered while skiing in Nevada. Gangrene set in so he was flown to a hospital in San Francisco, where they wanted to amputate. Friends brought him to the magnetic unit and two days later the gangrene was fading away. When the doctors went to operate the ankle had healed. The medical community refused to look at what they'd found.

If you've read any of the books I've recommended on the medical industry this will not surprise you.

Bioelectrification

Reader Baluch in Ohio wrote to say that he had taken a shortcut with the bioelectrifier. He used two dimes, a 27V battery (three 9Vs) and a microammeter and didn't bother switching polarity. He just tapped the current on and off. He said that he started losing weight immediately and is now down to his normal weight, his memory has improved (he's 72), and he's looking for some hair to start regrowing next.

Well, Bob Beck grew a new head of hair, so who knows? And then there's that chap who was struck by lightning and grew new hair *and* a new set of teeth. ■

Number 85 on your Feedback card

Updates

Frank speaks

... a far, far *brighter* thing I do ...

This comes from J. Frank Brumbaugh concerning his November '96 article, "A Low Current Light":

"After my article descended into the depths of the magazine's computer system, I discovered a source of brighter yellow LEDs: All Electronics, PO. Box 567, Van Nuys CA 91408-0567; Cat. #LED-29; four for $1.00. These are T 1-3/4 yellow LEDs, water clear, 2.1 volt at 20 mA. Each produces 550 mcd light level, much brighter than the diodes specified in the article. Use five LED-29s in series with a 120-ohm 1/4W resistor for a far brighter light source." ... J. Frank Brumbaugh

Continued on page 87

UNITED STATES POSTAL SERVICE (TM) Statement of Ownership, Management, and Circulation (Required by 39 U.S.C. 3685)

(1) Publication Title: 73 Amateur Radio Today (2) Publication No.: 1052-2522 (3) Filing Date: 09-13-96 (4) Issue Frequency: Monthly (5) No. of issues Published Annually: 12 (6) Annual Subscription Price: $24.97 (7) Complete Mailing Address: 70 Route 202 North, Peterborough, Hillsborough Cty., NH 03458-1107 (8) Complete Address of Headquarters or General Business Office of Publisher (Not Printer): 70 Route 202 North, Peterborough, NH 03458-1107 (9) Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor: S.S. Green, 70 Route 202 North, Peterborough, NH 03458; S.S. Green, 70 Route 202 North, Peterborough, NH 03458; F.I. Marion, 70 Route 202 North, Peterborough, NH 03458 (10) Owner: Shebroma Way Ltd., P.O. Box 60, Hancock, NH 03449; Sherry Smythe-Green, P.O. Box 60, Hancock, NH 03449 (11) Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities: None (12) (For completion by nonprofit organizations) (13) Publication Name: 73 Amateur Radio Today (14) Issue Date for Circulation Data Below: September 1996 (15) Extent and Nature of Circulation: Average No. Copies Each Issue During Preceding 12 Months; Actual No. Copies of Single Issue Published Nearest to Filing Date (a) Total No. Copies (Net Press Run) 71,010; 67,297 (b) Paid and/or requested Circulation (1) Sales Through Dealers and Carriers, Street Vendors, and Counter Sales (Not Mailed) 13,502; 13,468 (2) Paid or Requested Mail Subscriptions (include Advertisers Proof Copies/Exchange Copies) [illegible]

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

JAN 11

LOVELAND, CO The Northern Colorado ARC will host their Winter Superfest 9 AM–3 PM at the Larimer County Fairgrounds, 700 Railroad Ave. VE Exams, commercial exhibits, computer and radio goodies, more. Reserve tables from *Jeanene Gage NØYHY (970) 351-7327*. For general info, call *(970) 352-5304*. Talk-in on 145.115(-) 100 Hz.

PHOENIX, AZ The ThunderBird ARC will host the WestFesT-West Valley Hamfest at Glendale Community College, North Lot, 6000 W. Olive (Dunlap & 59th Ave.), starting at 6 AM. The event is being sponsored by the Amateur Radio Council of Arizona. Free admission, parking $2, tailgaters $5. Talk-in on 154.43- 146.52. Contact *Mark KC7BXS, (602) 931-1204;* or *Ralph WØDNO, (602) 582-8208.*

JAN 18

ST. JOSEPH, MO The Missouri Valley ARC, Green-Hills ARC and Ray-Clay ARC will sponsor the 7th annual Northwest Missouri Winter Hamfest, 9 AM–4 PM at the Ramada Inn. The motel is located at I-29 and Frederick Ave. (exit 47 on I-29), and is offering special rates for hamfest participants. Major exhibitors and flea market all indoors. Free parking. Admission by pre-reg. is $2 each or 3 for $5; at the door, $3 each or 2 for $5. Pre-reg. requests received after Jan. 8th will be held at the door. Swap tables $9 each for the first two tables. Commercial exhibitors welcome; write for details to *Northwest Missouri Winter Hamfest, c/o Gaylen Pearson WBØW, 1210 Midyett Rd., St. Joseph MO 64506.*

JAN 19

BROADWAY, OH A Winter Ham Radio Fair will be sponsored by the Union County ARC 8 AM–3 PM, on State Hwy. 347 three tenths of a mile west of State Route 31. Free parking. Tickets $2 at the door; no advance sales. Age 16 and under free. 8-foot tables $10 for full length, $5 for half. Reservations are encouraged. Please forward payment with an SASE to *Union County ARC, c/o Gene Moore N8YRF, 24461 Claibourne Rd., Marysville OH 43040. Tel. (937) 246-5943.*

RICHMOND, VA The Richmond Amateur Telecommunications. Soc. will hold "Frostfest 97" at the Showplace, 3000 Mechanicsville Tpke. I-95, exit 75 to I-64 East, then exit 192 (Rt. 360 East), go 1/2 mi. on left. Hours 8:30 AM–3:30 PM. Indoor dealers' flea market, forums. Wheelchair accessible. Talk-in 146.88/28. Admission $5. Dealers' tables $35, flea market tables $15 (must RSVP by Jan. 4th). *Contact Craig Spain, (804) 526-9838 eves., or write Richmond Frostfest '97, P.O. Box 932, Chester VA 23831.* For general info, call *(804) 739-2269, ext. FEST. Internet at http://frostfest.rats.net.*

YONKERS, NY A Giant Electronic Flea Market will be held by the Metro 70cm Network 9 AM–3 PM at Lincoln H.S., Kneeland Ave., Tel. (914) 969-1053. Doors open 7 AM for vendors, 9 AM for buyers. New and used equipment for CB, amateur radio, commercial two-way, computers, stereo buffs, electronics parts and kits, plus much more, will be on sale. Donation $6, kids under 12 free. Table setup at 7 AM. VE Exams 9 AM–11 AM. Contact *Otto Supliski WB2SLQ, (914) 969-1053.* Talk-in on 449.425 PL 156.7; 223.760 PL 67.0, 146.910 Hz, and 443.350 MHz PL 156.7. Mail reservations to *Metro 70 CM Network, 53 Hayward St., Yonkers NY 10704.*

JAN 26

DOVER, OH The Tusco ARC Hamfest will be held at the Ohio Nat'l. Guard Armory, 2800 N. Wooster Ave., starting at 8 AM. Setup starts at 6 AM. Admission $2 donation at the door. Tables are $8 each. For info and tables, contact *Tusco ARC, c/o Howard Blind KD8KF, 6288 Echo Lake Rd. NE, New Philadelphia OH 44663.* Please bring your own extension cords. 120 volts is available. Send reservation orders by Jan. 12th to *Tusco ARC, c/o Howard Blind KD8KF.* Talk-in on 146.730(-)

JAN 28

ODENTON, MD A Post Holiday Swapfest and Flea Market will be held by the Maryland Mobileers ARC 8 AM–2 PM at The Odenton Vol. Fire Dept. Hall, 1425 Annapolis Rd. (Route 175). Free VE exams, pre-reg. with *Jerry Gavin NU3D, (410) 761-1423.* Talk-in on 146.205/.805. Donation $3. Tables in advance $7 (table and one operator). Contact *Bill Ziegler KA6TYY, 1307 Ashburton Dr., Millersville MD 21108. Tel. (410) 987- 2384 eves.*

FEB 14

ORLANDO, FL The Orlando HamCation Show and Computer Show, ARRL North Florida Convention will be held at Central Florida Fairgrounds, Rt. 50, 3 mi. west of I-4. Sponsored by OARC of Orlando. Setup Fri. 9 AM–5 PM. Open to the public Fri. 5 PM–9 PM, swap tables only. Sat. 9 AM–5 PM; Sun. 9 AM–4 PM. Largest tailgate area in Florida. RV overnite parking $16. Advance tickets $6, $9 at the gate. Free parking. Swap tables $25/Tailgate $15 all 3 days. Forums: NASA Astronaut, Slide/Photo Exhibit of Lightning Storms, ARRL, APRS Demo by Bob Bruninga, WX Downloads, WX Equip. for the Home, Shortwave Listening by Bob Grove, Publ. *Monitoring Times*, Build a VHF SWR Meter, Grounding for Lightning, Antenna Workshop, Radio Testing, DX Speaker Al Hernandez and Ladies' Programs. For info and adv. tickets, contact *Orlando HamCation, P.O. Box 547811, Orlando FL 32854. E-mail: kd4jqr@aol.com. Web Page www.cycat.con/users/oarc.*

Number 87 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Seasonal lows in solar flux values, combined with the consistently low flux values (60s and low 70s) at the end of Cycle 22 and the beginning of Cycle 23 will *not* bring smiles to the faces of DXers this month. Conditions are expected to be Fair (F) or trending around Fair for many days of the month, but there will be *few* Good (G) days and *many* Poor (P) or Very Poor (VP) days... unfortunately, on weekends also. Geophysical upsets may be expected between the 5th and 7th as well.

10–12 meters

A few possible daytime F2 layer openings to South and Central America on the Good (G) days.

15–17 meters

Fair DX openings on Good (G) days between noon and sunset, and short-skip openings during the daylight hours. The band dies at sunset.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15	15
CANAL ZONE	15	20	20	40	40		20	20	15	15	15	15
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15	15
INDIA	20					20	40	20				15
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15	15
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15	15
SOUTH AFRICA			40	40				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						80	40	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15	20	20				40	20	20			
JAPAN						80	40	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40							15	15	20	20
U.S.S.R	40		40	40				20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40	40							15	15	20
U.S.S.R.		40	40	40	40				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

JANUARY 1997

SUN	MON	TUE	WED	THU	FRI	SAT
			1 F	2 F	3 F-P	4 P
5 P-VP	6 VP-P	7 P-F	8 F	9 F	10 F	11 F
12 F	13 F-G	14 G	15 G-F	16 F	17 F-P	18 P-VP
19 VP-P	20 P-F	21 F	22 F	23 F	24 F-G	25 G-F
26 F	27 F	28 F	29 F	30 F-G	31 G	

20 meters

DX to most areas of the world during daylight hours, peaking a few hours after sunrise and again during the early afternoon. Although the band usually closes soon after sunset, you may find occasional openings to South America and Antarctica until midnight. Daylight short skip from several hundred to 2,000 miles or so possible on most Good (G) or Fair (F) days.

30 meters

DX toward Europe in the late afternoon and evening on Good (G) days until midnight, and then toward the Orient in the early sunrise hours. Possible long-path DX in the morning and also short skip most days out to a thousand miles or more, and farther in the evening.

40 meters

DX toward Europe and Africa in late afternoon hours, toward South and Central America around sunset, and good openings to the West and South Pacific peaking around sunrise on Good (G) days. Expect daytime short skip to 1,000 miles, and 2,000 miles at night.

80–160 meters

Both are excellent bands for DX during hours of darkness, peaking at midnight and just before dawn. Daytime skip on 160 is nonexistent, but on 80 it can be up to 500 miles, and over 2,000 miles at night. On 160, short skip can reach from 1,000–2,500 miles at night. Experts prefer vertical polarization for transmitting antennas (low-angle signal take-off) and horizontal polarization for receiving antennas (less noise) on 160 meters.

When using the "Time, Band, Country" chart: Where 10 meters is shown, also check 12 meters; where 15 meters is shown, also check 12 meters; where 20 meters is shown, also check 17 meters; where 40 meters is shown, also check 30 meters. The ionosphere is *not* consistent at all times and locations; hence the bands shown are also inconsistent. 73

UPDATES

Continued from page 85

Yagi update

If a parts list seems a bit too small, it just may be.

Here is the list that was omitted from the October issue's "440 Yagi Link Antennas":

Parts List

For each antenna:

1	18" to 20" piece of 1" square aluminum boom stock
1	13-5/8" piece of 3/8" aluminum tubing (reflector)
1	13" piece of 3/8" aluminum tubing (driven element)
1	12-5/8" piece of 3/8" aluminum tubing (first director)
1	12-3/8" piece of 3/8" aluminum tubing (second director)
1	2-1/4" piece of 3/8" OD aluminum tubing
1	3/8" by 3-1/2" piece of thin aluminum sheet stock (for gamma match tube)
1	7/8" by 2-1/2" piece of thin aluminum sheet stock (for SO-239 mount)
6	#6 by 1" self-tapping stainless steel screws (for mounting all parts so far)
2	#4 by 3/8" machine bolts with nuts and washers (for gamma strap)
1	3-1/2" piece of RG-8 coax with outer cover and shield removed (gamma)
1	U clamp (for mounting boom to mast)

73

Including Ham Radio Fun!

FEBRUARY 1997
ISSUE #437
USA $3.95
CANADA $4.95

International Edition

73® Amateur Radio Today

Software Home-brewing see page 10...

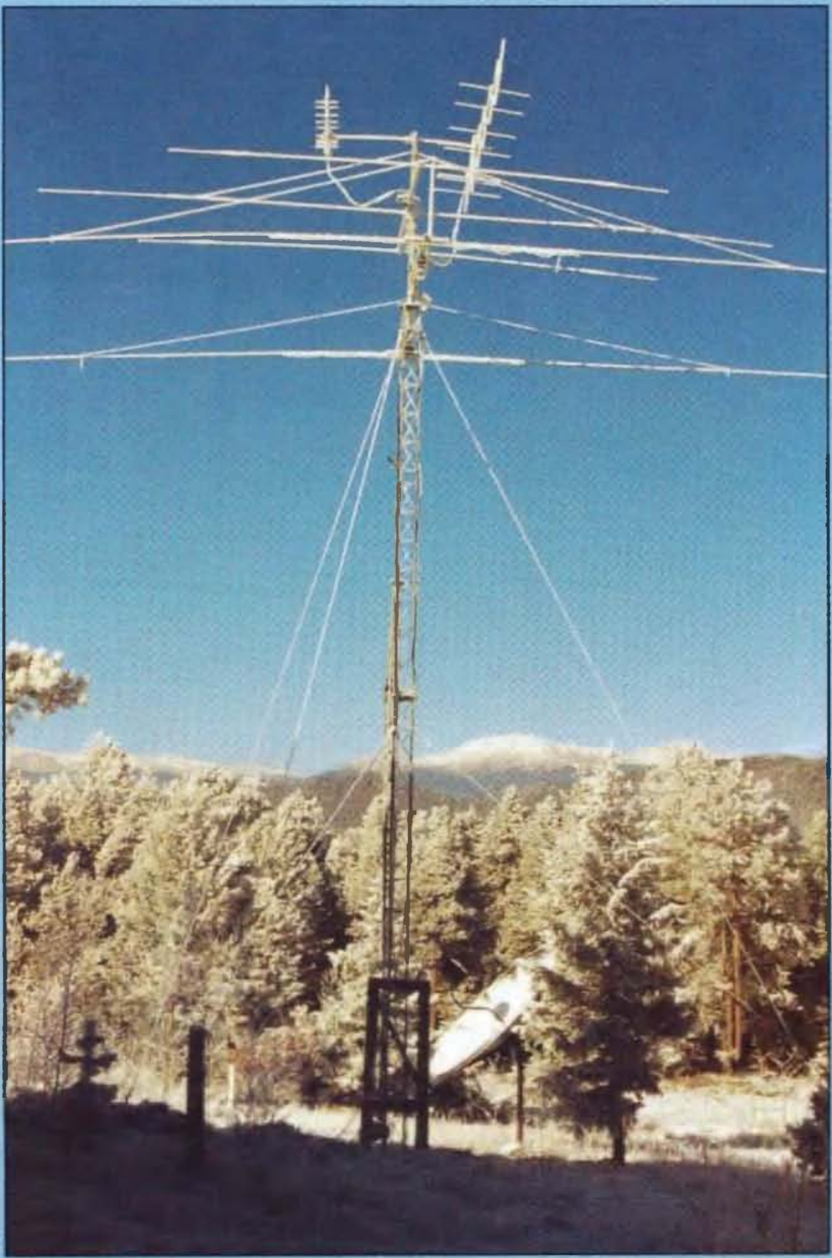


Photo by WØLMD

To Build:

Beam-aimer
Turbo Digi-sniffer
Gel Cell Charger
160m Antenna Tuner
Stealth Antennas

Reviews:

Ten-Tec 6m Transverter
Hamtronics RWX

0 74851 08725 1 02

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM (ok) or Mac (preferred) formats), carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

73 Amateur Radio Today

Including Ham Radio Fun!

FEBRUARY 1997
ISSUE #437

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

REVIEWS

HAM RADIO FUN SECTION

On the cover: Photo by Bob Suding WØLMD, who explains: "The picture is my 2 el 40 beam, my 3 el 30, 17, & 12 beam and my 2 & 3/4 beams for OSCAR @ 8,950 feet. Distant mountains are 15 miles away @ 14,000 feet."

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The entire contents ©1996 by 73 Magazine. No part of this publication may be reproduced without written permission of the publisher, which is not all that difficult to get. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edilion: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: See where natural ham curiosity gets you? Upon finishing reading the first sentence, you have formally contracted with 73 Amateur Radio today to be our grass-roots ad salesman. You know we give you more ham fun for the buck than the rest—it should be a cinch to make this clear to dealers and manufacturers.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

"The Weather Here ......"

When I hear those words I'm pretty sure the chap on the other end is going to be a dud contact. I don't give a rat's rump what his weather is unless there's been a tornado or something really worth talking about. And I honestly don't care what commercial rig he was able to afford, so none of that "The rig here is..." stuff either. That, too, tells me that he hasn't given any thought about what might be of interest to me, that I am just another formula contact for him. Gee, maybe he "needs" a NH QSL. Wowie, oh thrill! That's worth 32¢ for me anytime, plus filling out the card and looking up his address in the *Callbook*. Sure.

When you call me I want to know something about you, not what kind of an antenna or what rig you bought. One of the reasons I wander off ham radio in my editorials is my obviously wasted effort to get you to at least ask someone you're talking with if they've read my latest crazy editorial. And I recommend books which would give you endless things to talk about, if only I could get you to read them. Sigh.

Yes, I'll send you a confounded QSL. Oh yes, and roger on your rig, your antenna, your weather, and the serial number on your mike. But are you active on packet, satellites, the Internet? Have you worked any interesting DX lately, maybe even been somewhere interesting? What do you think about the possible (maybe probable, considering the ARRL's undiplomatic actions) loss of 2 meters? *Talk* to me!

Boilerplate

While I was at it I also put together a collection of 43 of my ham-oriented editorials for ham club newsletter editors to use as filler when their club members fail to provide enough fodder. Those small filler items in newspapers are called boilerplate.

I get around 50 club newsletters every month and while some are packed with interesting stories, others are awfully dull. Since only about 20% of the hams read *73*, it seemed to me that my editorials would be new for most newsletter readers, and could use some repetition for the others. And no snide remarks about my own repetition, please.

Any newsletter editor interested in getting some interesting filler can send me a copy of the newsletter and I'll send a *Boilerplate* book. Yes, I can dump any desired segments to disk, if that'll help. Mac Word format. If you just have a morbid interest in my past ham-oriented editorials the collection is $5. A steal.

Shocking

A newspaper article from Graham Rogers VK6RO cites another medical anomaly worth investigating. This has to do with a chap who was suffering from Ross River virus, which produces extreme fatigue and lasts a year or two. It's transmitted by mosquitoes. It seems this chap who was suffering from the virus had difficulty even getting out of bed. Then he accidentally got pushed into an electric fence and got a dandy shock. The next day he had recovered from the virus. He told a good friend of his who also was suffering from the virus about it. The friend came around and zapped himself on the fence and within 15 minutes his pains were gone.

Some time ago I wrote about the Amazon Indian cure for snake bite where they take the wire off their outboard motor spark plug and zap the bite to counteract the venom. Indeed, the jungle aviation flyers take along a spark coil system in their planes just for that emergency.

This ties right in with the letter from KA1UMW ("Letters") and his experiences.

Now, I suppose you're going to ask me why the medical industry is blind to these anomalies. How can they pass up researching electrical approaches to curing illnesses? You wouldn't ask that if you'd read the exposé books on the industry on my recommended list. The big money in the $1.5 trillion American medical industry is in selling medications. If the drug companies can't develop and patent a pharmaceutical which will bring in hundreds of millions, you aren't going to see it. Or have you bought any pills lately? And the pill and shot pushers are solidly backed up by the AMA, the FDA, and on down the list, complete with swat teams to put you in prison if you try to cause any trouble. Lordy, you should see some of the letters I've been getting from FDA prisoners around the country!

Perhaps you can understand why I'm so enthusiastic about the Beck blood purifier and Bioelectrifier (May issue).

Memorial

What do you want to be remembered for? If you ask a kid this he won't have an answer. It isn't until you're along in your 40s or so that you begin to understand what this means. We can't all leave great music or art behind as a memorial. Or even one stone in a great wall somewhere. So I sit here at my computer, listening to Gottschalk's incredibly beautiful music, goading you to help pioneer any of the endless frontiers of science which are wide open for exploration. Goading you to produce and raise the very best children you can. Goading you to help fix our schools, our health care system, and all the other things you've let our beloved Congress and president, solidly backed up by millions of bureaucrats, screw up. Will your memorial be a work of art? A book? A discovery? A lifetime score of 370 countries worked? Or perhaps a bunch of certificates for winning contests which will eventually get thrown out with those old boxes of QSL cards by your widow? Or just a weathering stone in a cemetery somewhere?

It doesn't take a lot of money to pioneer. Mostly it takes determination.

Speaking of bureaucrats, here's a quote I like: "A bureaucrat is the most despicable of men, though he is needed as vultures are needed, but one hardly admires vultures whom bureaucrats strangely resemble. I have yet to meet a bureaucrat who was not petty, dull, almost witless, crafty, or stupid, an oppressor or a thief, a holder of a little authority in which he delights, as a boy delights in possessing a vicious dog. Who can trust such creatures?" Cicero, circa 50 BC. Who says we haven't made progress in 2,000 years?

There's a whole world of mystery out there, waiting to be unraveled. Pick any thread and see where it takes you.

Congratulations!

Paul Harvey mentioned that our total taxes are now an average of 50.4% of our earnings, setting a new record. This is truly remarkable because in most other countries the people have revolted when the taxes got over 33%. So you are to be congratulated on your ability to get thoroughly screwed and yet keep on cheerfully smiling and re-electing your screwers.

Yes, it's sure nice to have our social security payments when we get old. Of course, if the same money had been invested privately we'd be getting over three times as much back. And the system wouldn't be looking at bankruptcy in a few more years. Sure, it's nice to have Medicare too. And never mind that if the government would let us invest our pre-tax earnings in health care insurance we'd get much better care at less than a

Continued on page 31

LETTERS

From the Ham Shack

Mike Zane K6URI. Late last year I wrote to you commenting on an editorial and mentioning our school ham radio club. You asked for information and photos. Here's the story.

First I contacted all the high school, junior high and elementary schools in our district to see if I could generate any interest in starting ham radio clubs. The three high schools, three junior highs and all but one elementary school were not interested. The only elementary school principal who was interested was one that my wife had taught for previously.

We started out in January 1992 in a portable classroom that was being used as a library. I drove my truck near the front door so we could use the mobile antenna with a portable rig set up in the room. This was not an ideal setup, but at least we could make local contacts. This got some students interested. We now have a locked cabinet on the stage of the auditorium/cafeteria.

We meet only one day a week for one hour after school. Some school terms I have eight to 10 students, and sometimes only three to five. Our school district is so overcrowded that the students are on a three-track system: on four months and off two months. Most of the kids do not come on their off-track time.

It took almost four months for the administration (not the principal) to give their "permission" to start the club. The only requirements were these: The kids had to have a ride home after school (those who were bused); the club was at *no cost* to the district or school; and I couldn't electrocute any of the kids. So far, we have met all three requirements. Through equipment donations, money for study books from our local adult city club, and my junk box, we have a pretty good setup. The station has an MFJ-1270c TNC, a Kenwood 10W TR-7600a, Kenwood TS-520s, Swan SWR/wattmeter, and a 386DX-40 computer. On the roof of the auditorium we have a 2m antenna and a 20/40m trap dipole.

Recently my wife Kristy KE6IQL got her Technician license and we decided to try to start another club at the elementary school where she teaches sixth grade. We got the principal to let us put a packet station in the classroom as a test. So, when she returns to school from off track, we will give it a go.

Our club at Nichols Elementary starts the kids out with some electricity experiments and then they build a basic crystal radio. The next item is a Morse code key, followed by a two-transistor code oscillator. Then the crystal radio is converted to a one-transistor AM radio, and a small audio amplifier is added. By the way, our club has students from grades four through six. Hopefully at the end of October, when my wife goes back on track, we will have another club going and good news to report. I would like to be able to have the club members at both schools get on ATV, which might generate some more interest.

Members of K6URI's elementary school club working on their crystal radios.

Harry Goldman, Tesla Coil Builders Assn. Does Bernard Finn have a problem? ("Letters," August 1996.) Mention Nikola Tesla and he gives a list of also rans. I call it the "Oh but..." syndrome. That is, you credit a person for his contributions to science and Finn comes up with the "Oh buts..." This game can be applied to anyone, Bell and the telephone, for example, as well as Edison for the incandescent lamp and the phonograph. It is no secret that there were others on their trail. And that's the crux of the argument—they were trailing and not leading. Surely Mr. Finn is aware of the fact that the Tesla polyphase patents were dragged through the courts. Although the courts considered the efforts of others, including those named by Finn, Tesla's patents were upheld in every case. When Niagara went on line in 1896, the famous Lord Kelvin declared that "Tesla had contributed more to electrical science than any man up to his time." Whew, that takes in a bunch of highly respected names.

I agree with Mr. Finn that Edison's incandescent lamp established a need for a source of electricity. But there were single-phase AC systems available at the time. Why, then, did so many years pass between the birth of the incandescent lamp and Niagara hydroelectric power? It is no coincidence that Niagara hydroelectric came into existence shortly after the appearance of Tesla's patents.

Much of the discussion above can be applied to the wireless telegraphy controversy. By 1893 Tesla had developed the principle of the four-circuit system of communications. The idea employed inductive coupling between the driving and working circuit, the importance of tuning both circuits, the idea of an oscillation transformer, the capacitance loaded open secondary, and tuned antenna circuits grounded at one end. Again, I agree with Mr. Finn that there were others who later applied their own innovative ideas. But they would have gotten nowhere without employing the above named components. The way to wireless telegraphy was through Tesla.

Tesla's contributions to wireless telegraphy did not go unnoticed by his peers. Tesla was hailed as the "father" of wireless telegraphy by L.W. Austin (leading U.S. Government radio expert), M.E. Giradeau (pioneer in French communications), A. Slaby (whose work helped to establish the Telefunken system in Germany), A. Popov (often referred to as the Russian Marconi), as well as by others. E.H. Armstrong (FM and advanced radio circuits) praised Tesla for his visionary work in wireless and credited Tesla as the originator of radio control systems. John S. Stone (named in the U.S. Supreme Court decision) stated that "Tesla was so far ahead of his time that the best of us mistook him for a dreamer."

With numerous awards, 15 honorary doctorates, a unit of measurement bearing his name, an IEEE annual award presented in his honor, and so on, it is difficult to understand why the Smithsonian can ignore Tesla's accomplishments.

The lack of artifacts is given as one reason. That situation did not stop MGM when it was preparing for the 1940 film "Edison, the Man." The studio sent its craftsmen to museums with Edison holdings to take photographs and make measurements. It took only six weeks to replicate Edison's most important inventions, and that includes the Pearl Street generating station. These were not Hollywood props but 1:1 scale working models! Tesla artifacts are in abundance at the Tesla Museum in Belgrade. I am confident that the Smithsonian crafts department is just as capable as MGM's.

Even if artifacts are lacking, the Smithsonian has numerous papers on Tesla's work that have been donated by engineers and historians. Why hasn't the Smithsonian used them to publish a monograph on Tesla?

And in conclusion, I might as well mention my own personal complaint. In 1994, a friend stated that he saw a portrait of Tesla at

the Smithsonian. Thinking that it might be something I do not already have, I sent a request for information. Two years have passed without a satisfactory reply even though I have sent reminders on two subsequent occasions.

The situation is a disgrace—another example of politics messing things up... Wayne.

Raymond Bergeron KA1UMW. When I was less than 12, I saw a little German chiropractor (Dr. Leonard A. Kaam) for relief from bronchitis symptoms, for an injury from a tree fall, and for Osgood Slatter's disease. This chiropractor had a "little black box" that ran on batteries. I would hold a solid brass probe in one hand while he probed the affected area with the other. He had a small figurine of the human body that was covered with numbers. When he wanted to treat my ailment or symptom (stuffed-up sinuses, for example), he would look up sinuses in a book. The book would give him a list of numbers which he would find on the figurine. He said that the numbers were nerve ending points. Using his probe, he would touch the area of my body as indicated by the numbers. A tone would come from the box and get louder as he approached the nerve ending (presumably by finding the least resistance). When the tone was the highest in pitch he would push a button on the probe and a series of electric pulses would run through me (they would often be a little painful) for about five seconds. After a few of these hits (around the nose for the sinus treatment), I would feel the dams bursting and my sinuses would be instantly clear, with the gunk running down the back of my throat. He would always tell me that his box could cure anything, clear up a blocked artery, etc. He even said if I ever had a heart attack or a stroke, not to go to the hospital but to go see him and he would clear it up instantly.

Well, he also had another gray box called a Century Mach IV Galvanic Stimulizer. This little device had a big pad that was soaked in warm water and placed on your back, and two smaller wet pads that are placed on the injured area. The machine would run an AC current through your body. The current was variable from nothing to painful, at a frequency from 30 to 120 Hz. The current would switch from Pad A to Pad B, going to the big common pad on your back at a rate of 2.5, 5, or 10 seconds. Well, as a late teen- and early 20-ager I started to service these little gray machines, which reportedly cost $5,000. My chiropractor managed to get a schematic for me so I could repair them. The unit was just a simple 36-volt pulsed variable-current generator, with a timer—sound familiar?

If you have any chiropractor friends ask them about the physics involved and it may help with the plant growth stimulator.

Hmm, is this another lost technology? Seems worthwhile investigating. Were those "nerve endings" actually acupuncture points? Maybe some of those fancy electrical gadgets of long ago which the "modern" medical industry ridicules actually did work! Of course, if your pioneering spirit has been totally decimated, then never mind. And for heaven's sake don't read the Robert Becker books... Wayne.

Mike Truax KB9OCE. Wayne, you recently asked to hear about Elmers, so I thought I would tell you about my Elmer: my brother Jerry Truax N3SEI. I first became interested in amateur radio 22 years ago. My main interest then, as it is now, was HF. I have an HW-9 that I built in the late eighties which has yet to go on the air. Every time I was ready to take the test, I either couldn't find the time and place of a test, or I was working. Finally, in June this year, after calling off from work, I took the test. I had originally planned on going for Tech+. However, when the VEs told me that I had only missed two on the entire exam, I was so excited that I knew I'd never be able to concentrate on the code. I raced home to call my brother with the good news. His encouragement (and stubbornness) had finally paid off. A few days later I received a package from him. He had sent me a 2m HT so that I could get on the air as soon as my license arrived! There was one string attached. Now I have to become an Elmer, and the first one that I Elmer gets the HT upon passing the exam... with the same string attached. That's a new twist on "incentive licensing" for sure!

I now have to study for the General. I wish I had done this years ago. Most of the blame is my own; however, for the general public, VE exams are one of the best-kept secrets around. I really think that our ranks would grow faster (and stronger) if more people knew about them. Our local Radio Shack™ knew nothing about local amateur radio activities, other than what I relayed to them. Most newspapers have a "community bulletin board" column. The newspapers can't print dates for VE exams or local club meetings, etc., if they don't know about them. The best part is that this is *free* advertising!

I suggest coverage of activities like Skywarn, Field Day, hamfests; the list goes on. I would really love to see an article about Bill KA9ONS, one of our local amateurs who normally runs our Weathernet. Bill and the guys do such a fantastic job. They too are part of the reason that I finally took time to get licensed. Hmmm, since I am a free-lance writer, maybe I'll write the article—after all, if we don't promote ourselves, nobody else will! Maybe our local club (and yours) could use a Publicity Chairman. Volunteer! Remember the old saying: "Volunteers can't be bought; they're priceless." It's true! Don't worry, Wayne, I have a few articles in the works for you that I will be sending as soon as my research is complete. We could trade my work for back issues of *73*. After all, they don't call you Never Spend a Dollar for nothing.

I would like to thank not only my brother Jerry N3SEI, but also you, Wayne, for the encouragement through your editorials (yes, somebody *was* listening!), Gordon West for his excellent study materials, our local Skywarn Weathernet, and our local VEs—John KF9YS, Mike WT9W, and Stan KD9BE—for giving up their valuable time so that a 22-year dream could become reality. Each and every one of you is my Elmer in your own way, and you

Continued on page 60

QRR . . .

Number 8 on your Feedback card

Scholarships for Licensed Hams

The Foundation for Amateur Radio, Inc., a nonprofit organization with headquarters in Washington D.C., plans to administer 60 scholarships for the academic year 1997-1998 to assist licensed radio amateurs. The Foundation, composed of over 75 local area amateur radio clubs, fully funds five of these scholarships with the income from grants and its annual Hamfest. The remaining 55 are administered by the Foundation without cost to the various donors.

Licensed radio amateurs may compete for these awards if they plan to pursue a full-time course of studies beyond high school and are enrolled in or have been accepted for enrollment at an accredited university, college or technical school. The awards range from $500 to $2,500, with preference given in some cases to residents of specified geographical areas or the pursuit of certain study programs. Clubs, especially those in Delaware, Florida, Maine, Maryland, New Jersey, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin, are encouraged to announce these opportunities at their meetings, in their club newsletters, during training classes, on their nets and on the World Wide Web home pages.

Additional information and an application form may be requested by letter or QSL card, postmarked prior to April 30, 1997, from:

FAR Scholarships
6903 Rhode Island Avenue
College Park MD 20740

The Foundation for Amateur Radio, incorporated in the District of Columbia, is an exempt organization under Section 501(C)(3) of the Internal Revenue Code of 1954. It is devoted exclusively to promoting the interests of amateur radio and those scientific, literary and educational pursuits that advance the purposes of the Amateur Radio Service.

73's "Survey" Winner

The winner of $100 plus a lifetime subscription to *73* is Harry Longerich of Fredericksburg, TX. Congratulations, Harry, and thank you for participating in the "Survey" in *73's* November issue.

Cities Will Challenge FCC

Look for major court challenges by city planners, community managers, and homeowners' associations to recent rulings by the FCC—rulings that forbid states, cities, municipalities, homeowners' associations, and even individual landlords from enacting rules preventing the installation of those pizza-sized satellite TV dishes.

When it used its power and preempted local jurisdiction and land use regulations to permit anyone to install one of the mini satellite antennas, the FCC said it was doing so to ensure that the general public had access to the latest in television transmission technology.

But according to recent news reports, some cities, states, and many homeowners' organizations disagree. A spokesman for a coalition of urban planning groups say that the federal government has no right to dictate the aesthetic look of a community; that controlling satellite dishes and any antenna structures must be done on a community planning level.

With both sides now having their views cast in concrete, it will be up to the legal system to decide who has the final word. Urban planners say that they will be going to court in an all-or-nothing effort to wrestle the power of federal preemption away from the FCC. While it will be many years before any final determination is made, whatever the outcome, the future of many radio services that use visible antennas—including amateur radio—may well hang in the balance.

Adapted from an editorial in the *"marcKey,"* official newsletter of the Manteca ARC, November 1996.

Ham's Best Friend

...like man's in general, is the dog. Why?

10. He doesn't need a chair.
9. He always answers your call.
8. He entertains you when the bands are dead.
7. He keeps your feet warm on cold winter nights.
6. He never reminds you how late it is.
5. He understands your frustration; he's been in a few dogfights himself.
4. He doesn't talk while you're trying to copy code.
3. He's one being whose CW skills are worse than yours.
2. He doesn't care how much you spend on QRP gear.
1. He listens before he barks.

By Steve Burel AD4LY (lifted from the *"ARNS Bulletin,"* December 1996, which lifted it from the Colorado QRP Club's official newsletter, *"The Low Down."*)

FCC Enacts Morse Code Requirement on Internet Access

(Note for the humor-impaired: This is satire. Please do not read this if you are not properly trained and certified in satire.)

The FCC, under pressure to clean up the Internet, especially after the Communications Decency Act provisions regarding Internet content were stricken as violating the U. S. Constitution, has decided instead to enact a Morse code proficiency requirement for Internet users. Citing the success of the Amateur Radio Service and the general belief that its requirement to operators to pass a Morse code proficiency exam, and other technical requirements, has kept the ARS "clean," the FCC will enact a 5 word-per-minute requirement for all Internet users. They are leaving open the issue of whether there should be a "codeless" class of Internet user and are soliciting comments for proposed rule making on this proposal.

Persons wishing to develop a web site having only links to other web sites which in turn have only links to other web sites, and so forth, must pass a 13 word-per-minute Morse code test and demonstrate proficiency in HTML, the Internet authoring language.

Persons who wish to develop web sites that have actual content, as compared to just links to other web sites, must pass a 20 word-per-minute Morse proficiency test, demonstrate proficiency in HTML and the Java programming language, and show that they have mastery of at least one human language, such as English.

The FCC, which lacks budgetary authority to implement the testing program, has stated that it intends to create a Volunteer Examiner Program to test Internet applicants.

Swiped in its entirety from Clear Lake ARC's *"Radio Amateur Gazette,"* October/November 1996.

Tucker Out of Ham Biz

Tucker Electronics Company, a distributor of new and reconditioned electronic test and measurement equipment, amateur and shortwave radios, and electronic hobbyist products, has announced the sale of all its ham radio-related assets (including the recently acquired Oklahoma Comm Center) to Ham Radio Outlet.

Tucker Electronics has discontinued operations of its retail store in Dallas and its consumer mail-order business; the toll-free ordering number is being serviced through HRO's New Hampshire store. At last report, Tucker is marketing its vintage radios and any inventory not acquired by HRO on its web site (www.tucker.com).

The sale of its amateur radio business will allow Tucker Electronics to focus on its core business, distributing new and reconditioned electronic test and measurement equipment.

Nautical Smiles

The following transcript of a radio conversation between a US Navy ship and a Canadian source off the coast of Newfoundland was released by the Chief of Naval Operations on Oct. 10:

US Ship: Please divert your course 15 degrees to the north to avoid a collision.

Canadian: Recommend you divert YOUR course 15 degrees.

US Ship: This is the captain of a US Navy ship. I say again, divert your course.

Canadian: No, I say again, divert YOUR course.

US Ship: This is an aircraft carrier of the US Navy. We are a large warship. Divert your course now!

Canadian: This is a lighthouse. Your call...

Reprinted from the newsletter of the Escondido Amateur Radio Society, November 1996, who reprinted it from Ham Radio Online Internet magazine.

Continued on page 53

Amateur Radio and Linux

Software home-brewing is here!

Richard Parry W9IF
13842 Deergrass Court
Poway CA 92064-2276

October 5, 1991: "Do you pine for the nice days of Minix-1.1, when men were men and wrote their own device drivers? Are you without a nice project and just dying to cut your teeth on an OS you can try to modify for your needs? Are you finding it frustrating when everything works on Minix? No more all-nighters to get a nifty program working? Then this post might be just for you."

With that simple introduction, Linus Torvalds, a Finnish graduate student, announced to the world Version 0.02 of Linux on the USENET newsgroup comp.os.minix. Linux is pronounced "Lean-nucks," based on the Finnish pronunciation of Linus. Linux is a perfect platform for software development for amateur radio. It offers a plethora of freely distributed high quality software and a knowledgeable and helpful community of people (very much like the amateur radio community) ready, willing, and able to help; kind of like a ham's "Elmer." Although credit for the original idea for Linux must go to Linus Torvalds, the kernel and copious other software are the result of an international collaboration of dedicated people.

No doubt the gamut of readers of this article range from those who use Linux on a daily basis at work and/or home to those who have never heard of it. For those who fall into the latter category, Linux is a 32-bit, multi-tasking, multi-user, freely distributed UNIX-like operating system. Technically, Linux is only the kernel or core of the operating system; however, in general it represents all the software that normally comes with a complete distribution. Platforms upon which Linux runs include: DEC Alpha, Commodore AMIGA, Sun Sparc, MIPS, Atari ST, and Apple Macintosh. However, without a doubt, the 386, 486, and Pentium based systems are the most popular. Linux is not copyrighted and there is no AT&T code included (UNIX was born at AT&T). Linux is licensed under the Free Software Foundation's General Public License which specifies, among other things, that the source code must be freely available. It is the inclusion of the source code that is perhaps most unique. If you ever wondered how an operating system, network, compiler, assembler, or editor works, it is all there for you to study and modify to your heart's content.

There was a time when most ham radio operators built all or part of their amateur radio stations. I have built my share of transmitters, electronic keyers, RTTY widgets, antennas and more. The desire to build was based on the thrill of learning and building. In fact, I remember taking months to build a nifty gadget for the shack, using it for a week to see if it worked, and then returning to thinking of something else to build. I believe most of the amateur radio community feels the same way. However, home-brewing now includes software, and for that development Linux is the perfect platform.

"Where else but with Linux can you get the complete source code for a C++ compiler, an operating system, and the support of hundreds of thousands of users worldwide?"

Who is it for?

At the PACIFICON conference Bruce Perens AB6YM commented, "There's a saying that marketing people have about programmers: 'Leave a programmer alone, and he'll come up with the kind of product that only a programmer could love.' That's what UNIX is, and Linux too. Actually, other kinds of propeller-heads such as hardware designers, mathematicians, etc. have been known to be comfortable with UNIX and Linux. But why use an operating system that only a nerd could love? Well, you want them to write more software, don't you? UNIX and Linux are the most comfortable platforms for the development of sophisticated software that communicates, controls hardware, does complicated math ... what I'm trying to say is that it's the best platform for developing the kinds of software that radio amateurs need."

Who is Linux for? "Not for everyone" is the simple answer. Linux and UNIX are industrial grade operating systems. They both support a wide variety of GUIs (Graphical User Interfaces), but they are predominately a CLI (Command Line Interface). They are powerful, but with power and flexibility comes some complexity. Matt Welsh begins his book (see references) with, "Before you looms one of the most complex and utterly intimidating systems ever written: Linux, the free UNIX clone for the personal computer, produced by a mish-mash team of UNIX gurus, hackers, and

10 Ways to Tell if Linux is for You
1. You don't own *DOS for DUMMIES.*
2. You don't hate typing.
3. You don't mind reading manuals.
4. You don't like going to bed before midnight.
5. You don't own *Internet for Idiots.*
6. You do like learning.
7. You do like challenges.
8. You do like to build.
9. You do like to experiment.
10. You can stop the VCR from blinking 12:00.

Table 1. *A humorous checklist to aid you in making the decision to use Linux. However, as with all humor, there is always an element of truth.*

the occasional loon. The system itself reflects this complex heritage, and although the development of Linux may appear to be a disorganized volunteer effort, the system is powerful, fast, and free. It is a true 32-bit operating system solution."

If Matt's introduction has not scared you, then a more humorous test to see if you are ready for Linux is included in **Table 1**. Since you probably already have the hardware, a personal computer, and Linux is free, you have nothing to lose and a whole lot to gain. UNIX and Linux experience on a resume never hurt anyone!

What's available?

Just about everything you can imagine for serious software development is available for Linux. But that is only part of the story. The fact that it all comes with the source code and the enthusiastic support of authors and users worldwide means you can probably get an answer to your question within hours, and that includes 3 a.m. Much of the documentation for Linux comes from the Linux Documentation Project (LDP) in the form of HOWTOs. These documents typically range from 10 to 50 pages and provide in-depth information on a particular subject. There are currently 50+ HOWTOs to aid the user with Ethernet, XFree86, sound, video, networking, and more. For the amateur radio community, there are two in particular, a HAM and AX.25 HOWTO. **Table 2** is based on the HAM HOWTO and includes a summary of the software available for amateur radio. This document and other HOWTOs can be obtained from: http://sunsite.unc.edu/mdw/HOWTO and other mirror sites.

However, the purpose of this article and of Linux is not to get you started assembling a computer system based completely on applications that you can download; it is to inform the amateur radio community of an operating system (OS) that is an experimenter's dream. Here is your chance to learn C, C++, Perl, awk, Smalltalk, Tcl/Tk, FORTRAN, Python, shell scripts, networking, real-time systems, and more. It is a chance to put together a TCP/IP packet network that cannot be duplicated on any other platform. The reason for this is that the packet radio protocol is now built right into the kernel. Linux is the only operating system in the world that can boast standard and native support for amateur radio protocols. In fact, packet radio uses the same interface as the Internet. Therefore, any program which you use on the Internet can also be used as a packet radio program. For example, your favorite Internet programs such as Netscape, Mosaic, telnet, and ftp will work and not care, or know, that the medium they are using is packet radio.

Getting started

Table 3 shows the hardware for a comfortable system upon which to install Linux. I want to emphasize the word "comfortable," since you can get away with a lot less, especially hard drive space. However, most of you are not going to give up DOS or Windows 3.x right away (this might eventually happen, however) so you will want to make a partition on the hard disk for your DOS environment and another for Linux. One of the great benefits of Linux is that you don't have to give up anything you currently use. If you fear that Linux means leaving your current OS behind, fear not, Linux offers emulations for DOS, SVR3 UNIX, SVR4 UNIX, Macintosh and even older computers such as the Apple II and Commodore 64. For those of you who like GUIs, Linux has many to choose from. There are several versions of X Windows, including: twm, fvwm, and

Packet Radio	
	JNOS
	TNOS
	NØARY Packet BBS for UN*X
	LBBS - Linux BBS message gateway
	MBL/RLI message to NNTP and E-mail converter
	Packet Cluster Node software
	Single floppy disk AX.25 router
	DPTNT Terminal & BBS package
	IPIP encapsulation daemon
	AXIP encapsulation daemon
	Ping-Pong Convers Server
	RSPF Daemon
	Michael Westfall's TTYLINK Daemon
	Craig Small's TTYLINK Daemon
Morse Code	
	GW4PTS Morse Trainer
	morse (aka superiormorse)
AMTOR Software	
PACTOR Software	
Slow-Scan Television Software	
Facsimilie Software	
Design and Construction Software	
	Software oscilloscope
	Printed circuit board design tool
	Chipmunk circuit design and simulation tool
	irism
	Spice vers. 3f4
	svgafft - Spectrum Analyser
	Audio Spectrum Analyser
	ObjectProDSP
Training/Educational Software	
Miscellaneous Software	
	Linux for HAMS CD-ROM
	SunClock
	Xearth

Table 2. *Partial list of amateur radio Linux software taken from the HAM HOWTO documentation written by Terry Dawson VK2KTJ. The entire HOWTO is available at: http://sunsite.unc.edu/mdw/HOWTO/HAM-HOWTO.html.*

386 machine or better.
8 MB RAM (more is better).
20 MB hard drive (SCSI, IDE, etc.).
Floppy drive (1.44 MB high density).
CD-ROM (any speed, SCSI, IDE, etc.).
Video card supported by Linux.
Mouse (3-button type preferred).

***Table 3.** Linux runs on many platforms; however, for most hams the platform of choice is the PC. Shown here is a good hardware configuration for Linux software development.*

others. X Windows is a very powerful interface which allows great configuration flexibility.

Regarding file formats, as you survey the various distributions you will come across the terms "a.out" and "ELF" (Executable and Linking Format). Both are binary formats, the former being used for many years but now falling into disuse due to the advantages of ELF. The Linux community supports both formats during the current transition period. All of the distributions listed in **Table 4** support ELF.

During the installation of Linux you will be asked questions about your system's hardware configuration. Chances are you are using standard port assignments and addresses and the installation will go smoothly, but you should have your documentation handy just in case. For example, you might need to know your serial and parallel ports' I/O memory locations, and the IRQ (interrupt) addresses for devices (e.g., serial ports, sound cards, SCSI ports, video card, etc.). If you are not sure, most of the scripts have a default value to suggest, and in most cases you can't go too far astray sticking to the defaults in lieu of firsthand knowledge. Unless you have done

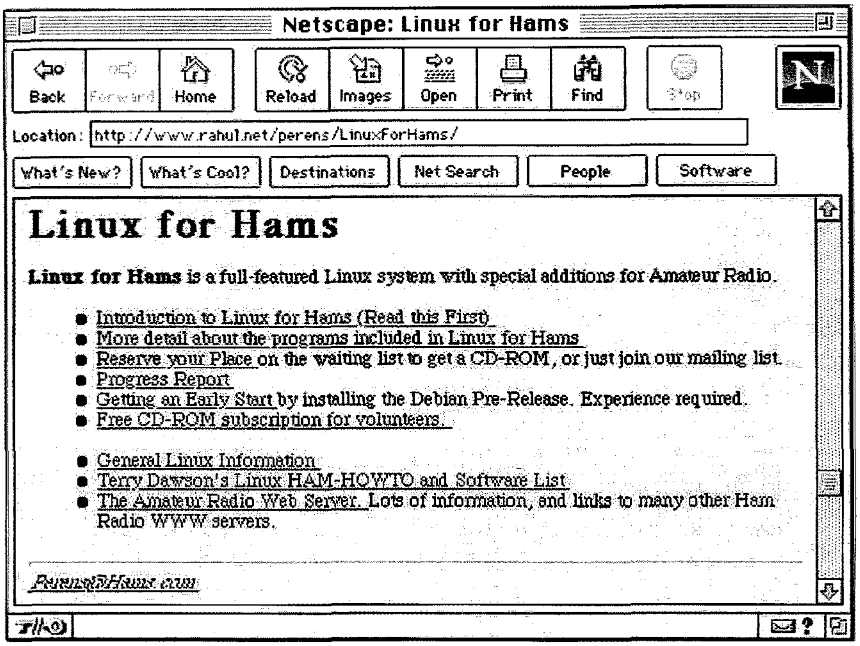


Fig. 1. The Linux for Hams homepage maintained by Bruce Perens AB6YM. Available at: http://www.rahul.net/persens/LinuxForHams/.

something strange with your hardware configuration, the defaults should work fine.

Although I said that everything for Linux is free and can be downloaded from the Internet, I would not advise that for anyone, even a UNIX guru. A small Linux installation can consist of a thousand or more files easily consuming 50+ MB of space. A complete installation which includes source code, copious documentation, computer languages and examples, and the X Window system can easily take up much more (e.g. 500+ MB). For this reason downloading is not practical. Fortunately, there are many CD-ROM publishers who include a complete distribution of Linux along with excellent installation software.

There is a lot more to Linux than the kernel. There are editors, compilers, linkers, assemblers, and utilities, to name a few items. In fact, in most distributions you will get several of each. For example, I have at least six different editors, although I use only one (emacs). For this reason it is not unusual for a distribution to consist of two or three CD-ROMs. In fact, Matt Welsh's book (see references) can be purchased separately or with a 5 CD-ROM Linux distribution. The prices for all of the distributions are reasonable and they are well worth it.

Another reason for using CD-ROMs is to take advantage of the "installation scripts" that accompany the distributions, some of which provide a graphical user interface. These installation scripts will walk you through the installation process, asking you questions about your system. Don't worry that you will be shielded from knowing exactly what is going on during the installation—there will be plenty of time for you to explore Linux later.

Another source for information is your local bookstore. Go to the computer section and chances are you will be surprised at the number of books devoted to Linux. I counted over a dozen during a recent visit, and there are many more that can help you during installation, configuration, networking, and more.

Last, and certainly not least, the World Wide Web is a great source of information. I have included a list of key web sites to visit in the references. Of particular interest to amateur radio operators is Bruce Perens' Linux for Hams homepage, shown in **Fig. 1**.

Figs. 2 and **3** illustrate two of the many other features of interest to ham radio operators. **Fig. 2** shows one of the SatTrack windows written by Manfred Bester DL5KR. SatTrack is a satellite orbit prediction and real-time tracking program with X Window System color graphics displays. It has been written in the C language and runs on UNIX and Linux systems, using only basic X11 and X11 Toolkit functions for the graphics displays. The program not only displays in real-time where a number of satellites are, but is also capable of controlling suitable ground station equipment, like

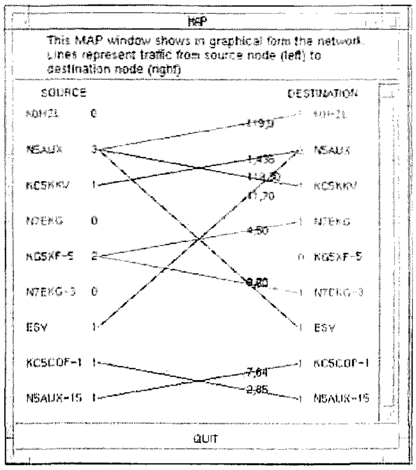


Fig. 3. A MAP window from XNET, a network analyzer designed specifically to monitor AX.25 packet radio networks.

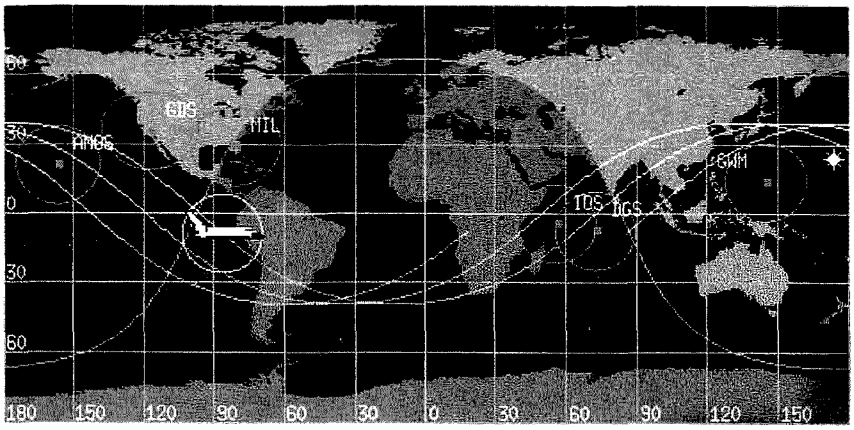


Fig. 2. A SatTrack window written by Manfred Bester DL5KR.

antennas or optical telescopes, radio communications hardware or other sensors. An autotrack mode can track any number of satellites and switches automatically between them as they rise and set. Predictions of passes of satellites over specified ground stations can be run off, either interactively or in batch mode. The page is located at: http://www.primenet.com/~bester/bts.html.

Fig. 3 shows a window from XNET, written by Richard Parry W9IF. This is a network analyzer designed specifically to monitor AX.25 packet radio networks. It will collect and display network data, allowing the user to understand network traffic and channel utilization. XNET was written in

"Linux offers a chance to put together a TCP/IP packet network that cannot be duplicated on any other platform—the packet radio protocol is now built right into the kernel."

Tcl/Tk and provides many features that are useful to both the casual packet user and the packet radio BBS sysop wishing to better understand the network. The XNET homepage is: http://www.qualcomm.com/~rparry/xnet.html.

Conclusion

Almost every amateur radio operator has been asked, "What is amateur radio?" There are a variety of answers and none are incorrect. For me, amateur radio is the thrill and excitement of experimentation, with both software and hardware.

If you need to write a letter, do your taxes or develop a spreadsheet, there are computer systems that do that, and do it very well. They give you the power to be your best and concentrate on the task at hand. For software development, however, you can't beat Linux. Where else can you get the complete source code for a C++ compiler, an operating system, and the support of hundreds of thousands of users worldwide?

Debian	http://www.debian.org	n/a
Craftworks	http://www.craftwork.com	$89.95
Linux Universe	http://www.springer-ny.com/samples/linux/l-inux.html	$34.95
Red Hat	http://www.redhat.com	$49.95
Slackware	http://www.cdrom.com/titles/slackware.html	$39.95
Yggdrasil	http://www.yggdrasil.com	$39.95

Table 4. *Shown here is a list of popular Linux distributions. Although you can download everything on these CD-ROMs for free from the Internet, using a CD-ROM for installation is preferred. The time saved is well worth the price.*

References:

1. Bible, Steve, "Amateur Radio on the World Wide Web—Part 2," *QST*, July 1995, pp. 37-40.

2. Kirch, Olaf, *Linux Network Administrator's Guide*, O'Reilly & Associates, 1995, ISBN 1-56592-087-2.

3. Lantz, Brian, "Using Ham Radios with Linux," *Linux Journal*, May 1995, pp. 26-39.

4. The Linux Journal Staff, "Linux Distributions Compared," *Linux Journal*, March 1996, pp. 24-65.

5. Strobel, Stefan; Uhl, Thomas, *Linux: Unleashing the Workstation in Your PC*, Springer-Verlag, Berlin Heidelberg, Germany, 1994, ISBN 0-387-58077-8.

6. Welsh, Matt, *Linux Installation and Getting Started*, Specialized Systems Consultants, Seattle WA, 1994, ISBN 0-916151-77-8.

7. Yggdrasil Computing, *The Linux Bible*, Yggdrasil Computing Incorporated, San Jose CA, 1995, ISBN 1-883601-10-X.

8. Linux newsgroups:
comp.os.linux
comp.os.linux.advocacy
comp.os.linux.announce
comp.os.linux.answers
comp.os.linux.development
comp.os.linux.development.apps
comp.os.linux.development.system
comp.os.linux.hardware
comp.os.linux.m68k
comp.os.linux.misc
comp.os.linux.networking
comp.os.linux.setup
comp.os.linux.x

9. Linux general information web sites:
http://sunsite.unc.edu/mdw/linux.html
http://www.redhat.com/lg/gazette_toc.html
http://www.geog.ubc.ca/sparclinux.html

10. Linux and amateur radio web sites:
http://www.rahul.net/perens/LinuxForHams/
http://sunsite.unc.edu/mdw/HOWTO/HAM-HOWTO.html
http://www.Hams.com/perens/HamRadio/LinuxAndAmateurRadio.html
http://www.inx.de/~wahlm/
http://hppool0.rz.hu-berlin.de/~h0187akk/
http://www.qualcomm.com/~rparry/xnet.html

Elegant Rotating—Revisited

An enhanced beam-aiming circuit.

Chet Garrison W6ZZB
3544 E. Dayton Ave.
Fresno CA 93726

A year or so ago, I was browsing through older issues of *73* and I came across an article titled "Elegant Rotating," by L. B. Cebic W4RNL (*73*, June 1984). His article dealt with an earlier beam-aiming circuit by K9AZG (*73*, November 1982), and offered some interesting improvements. The circuit is used to control CDE and similar rotor control boxes so that by setting a single potentiometer you can sit back and wait while the beam is aimed at the desired setting and stops, automatically.

I don't know why I ignored the article at that time, but when I read the article again I decided to build it for myself because my rotor was of the CDE variety.

I put the circuit together using point-to-point wiring and perfboard, and it worked beautifully! Because it was ugly, I hid it in a cabinet with a nice-looking front panel before I began using it.

Since then my oldest son has become licensed (KC6JAI). He and my friend W6BJI asked me to build an aimer circuit for each of them. One had a CDE, the other a "tail twister" rotor.

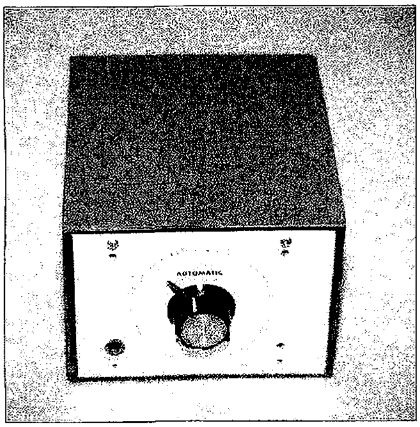


Photo A. One of the partially-completed beam-aimers.

In the meantime I had obtained a computer-aided design (CAD) program so I set out to make a circuit board for the aimer, and it was successful. (It wasn't easy, but the results were very gratifying.)

Before submitting this article to *73*, I contacted W4RNL and asked for permission to use information, including circuit diagrams, from his article. He replied and said OK, but also suggested I include some sort of audible device to help sightless operators, hence the little circuit added to the power supply board. Rotating the beam in CW direction produces a tone of one frequency, while rotating in the other direction produces a different tone (more about this later).

I'm very happy with the results and have since replaced the original effort with a newer, and much neater, circuit. With this circuit I can rotate my beam a full 360 degrees, stopping anywhere I want.

The circuit

I don't feel that it is necessary to go into K4RNL's article all that much. I refer anyone wanting to build this

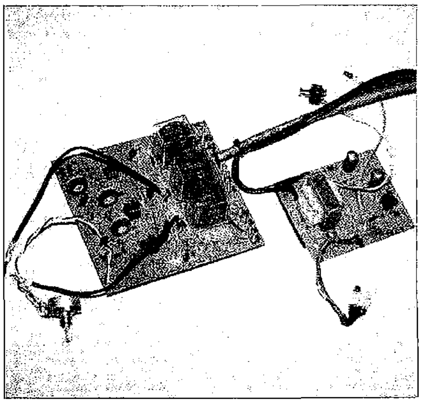


Photo B. The main aimer board and the separate power supply board.

rotator control circuit who feels the need for some theoretical information to the article in the June 1984 issue of *73*.

Instead, I have only included K4RNL's circuit diagram, **Fig. 1**. Please note the following correction to his original circuit: The top normally-closed contact of K1 is *not* connected to the top normally-closed contact of K2. The upper moving contacts of both K1 and K2 *are* connected to terminal #2 (common).

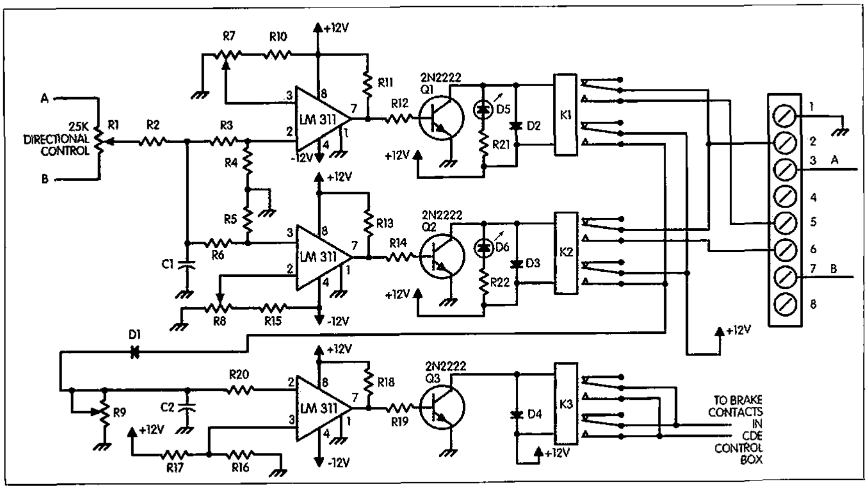


Fig. 1. K4RNL's original circuit diagram.

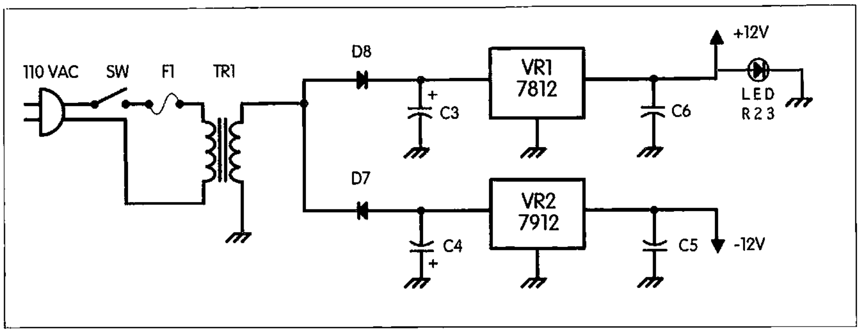


Fig. 2. K4RNL's power supply.

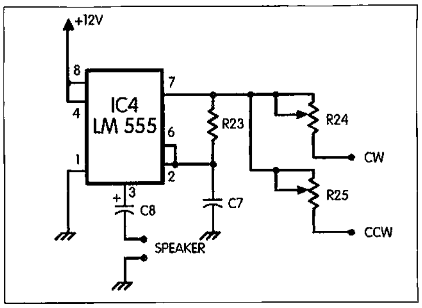


Fig. 3. K4RNL's audio oscillator.

Fig. 2 shows K4RNL's power supply; **Fig. 3** shows the audio oscillator. There are four important potentiometers in the aimer circuit: R1, R7, R8 and R9; and two in the audio circuit: R24 and R25.

R1 is the potentiometer used to control the rotation of the rotor, while R7 and R8 are used to adjust the rotor stop points when the rotor reaches the end of rotation. They are adjusted to turn off the aimer circuit when full clockwise or counterclockwise points have been reached.

R9 is used to adjust the delay time of the brake circuit. This adjustment allows for instant to several seconds of delay before the brake is applied. This an important feature; it allows the beam to coast to a stop before the brake is applied. A beam antenna, even a small one, can develop quite a lot of torque when stopped suddenly.

R24 and R25 are used to adjust the tones of the alarm while the beam is turning in one direction or the other—one tone for one direction and another for the opposite direction. This is an adjunct for the vision-impaired operator but can be deleted if it's not needed or desired.

The oscillator is plenty loud and, as in my case, a small speaker can be mounted inside the enclosure. A convenient spot is on the power supply board adjacent to the speaker connections. The values I have chosen in the oscillator circuit developed pleasant tones for me.

Fig. 4 shows the automatic beam-aimer circuit board (at 100% of actual size), ready for use with photocopier transfer system. **Fig. 5** is the component side of that same board, showing parts placement. **Fig. 6** shows the power supply board, and **Fig. 7** shows the component side of the board and placement of the components.

Photo A shows one of the partially completed beam-aimers. LEDs at the left and right upper corners indicate which direction the rotor is turning. At the lower left corner there will be a power switch and in the lower right corner there will be an LED "Power On" lamp. **Photo B** shows the main aimer board and the separate power supply board. Unfortunately, the power supply board is not the one with the oscillator. **Photo C** shows how I "stacked" the two boards in order to minimize the overall dimensions of the final enclosure. The current PC board layout allows the power supply board to be stacked above the main board for better heat dissipation.

Construction suggestions

Assuming you have etched or purchased the circuit boards, check all traces to be sure there are no breaks

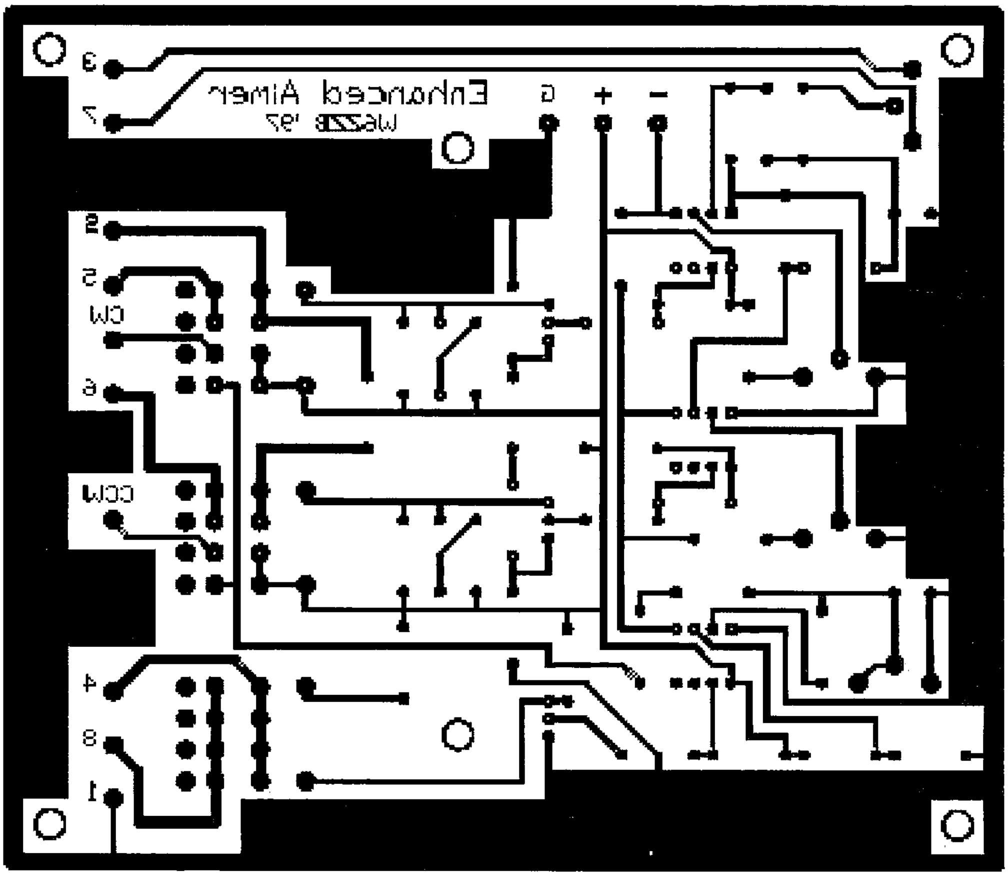


Fig. 4. Automatic beam-aimer circuit board, solder side (shown at 100% of actual size).

anywhere. Visual inspection may not be good enough so I suggest a continuity check using an ohmmeter. Assuming everything is OK, you may start installing the components.

I recommend completing the power supply board first and checking it carefully. Install a fuse holder and a fuse, the LED, the power switch and the AC cord. Plug the board into a source of AC and turn it on.

There should be ±12 volts DC between "G" and the positive terminal, and ±12 volts DC between "G" and the negative terminal. You can now check the oscillator by temporarily connecting a lead from the positive terminal first to the "CW" terminal, then to the "CCW" terminal, adjusting the potentiometers for a pleasing tone. Turn off the power supply and continue with the project.

In regard to the main board, I suggest strongly that IC sockets be used in all cases because if you happen to get a bad IC, it isn't easy to remove the IC without destroying the circuit board. I also suggest that these sockets, as well as the insulated jumpers, be installed first, then the rest of the components, with the relays installed last. Jumpers J1 through J9 are simply insulated wire jumpers. Check all the parts to be sure they are the right size and/or polarity.

When you have completed the installation of all the parts, connect the two boards together, with "G," "+" and "-" on the power supply board connected to similar points on the main board. Also connect "CW" and "CCW" from the power supply board to similar points on the main board.

Testing

You are now ready to do some checking. First, connect a 500 ohm potentiometer to terminals #3 and #7, with the arm of the pot connected to terminal #1. This will be your "rotor pot" for the following tests. Turn this pot fully clockwise. Also, connect a separate source of 12 to 15 volts DC, positive to terminal #3 and negative to #7.

Plug the aimer to a source of AC and turn it on. If the voltages are OK, proceed with the next test.

In the event the CCW LED is on, reverse leads 3 and 7 on the rotor pot, then adjust R7 to turn off that lamp.

Now turn R1 to about midpoint; the CCW LED should light up. Now turn the rotor pot slowly counterclockwise until the CCW LED goes out. Continue

turning the pot in the same direction and the clockwise LED should go on.

Turn both pots fully counterclockwise and adjust R8 so that the aimer circuit turns off; the CCW LED will go off. Now turn both pots fully clockwise and adjust R7 to turn the aimer circuit off and the CW LED will go off, too. Both of these adjustments will have to be repeated when you actually connect the aimer to your rotor control box.

A special note regarding the brake circuit: You must bring leads from terminals #4 and #8 to the inside of your control box and connect them to the "open" brake contacts of the direction control switch. In each of my cases I installed an eight-prong "Jones type" socket at the back of the control box, connecting all the numbered terminals to like-numbered terminals, except #4 and #8. This is the easiest method of putting it all together, believe me!

When you first rotate your new system, turn your beam to each extreme and again adjust R7 and R8 in order to turn off the aimer circuit. Also, adjust R9 for a few seconds of delay in order to allow the beam to coast to a stop.

Instead of a normal pot at R1, a 12-position switch might be installed with 2,000 ohm resistors between each contact. I tried this idea and was satisfied with the results. Now, instead of holding a switch while my beam turns I simply dial in the heading, and get back to operating!

Continued on page 69

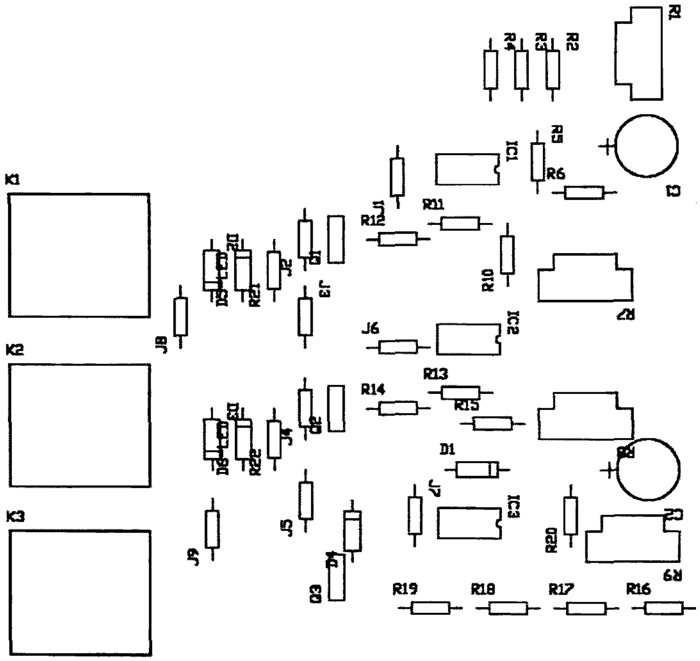


Fig. 5. Component side of the circuit board, showing parts placement (not to scale).

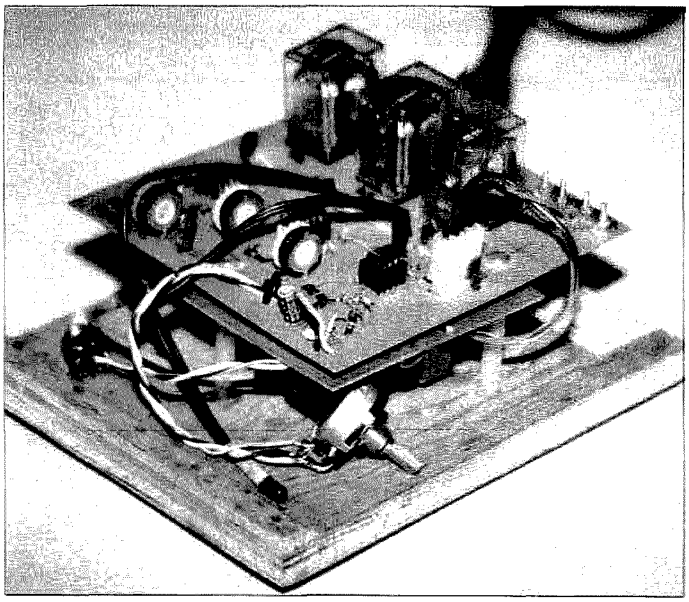


Photo C. *I "stacked" the two boards in order to minimize the overall dimensions of the final enclosure.*

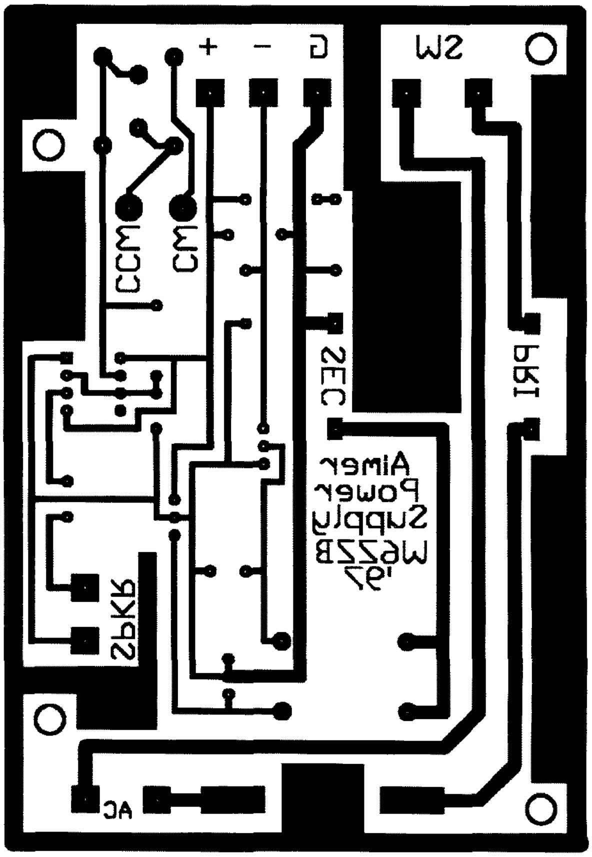


Fig. 6. *Power supply circuit board (actual size).*

Antenna Tuners

Do we really need them?

Robert W. Vreeland W6YBT
45 Maywood Drive
San Francisco CA 94127

Many hams use antenna tuners that are larger than their QRP rigs. Is this really necessary? While most transceivers are designed to withstand a three-to-one mismatch, this doesn't mean that they should be operated that way. I decided to find out what my MFJ-9020 would deliver to a purely resistive mismatch. It put out 3.3 watts into a 50 ohm load and 3.2 watts into 25 ohms. Not bad! The output dropped to 2.8 watts for 82 ohms, 2.6 watts for 100 ohms and a paltry 2.1 watts with a 135 ohm load. Apparently the MFJ-9020 prefers loads of 50 ohms or less.

Fortunately, most portable antennas will have an impedance in this range. According to Terman a half-wave horizontal dipole must be hung at a height of more than 1/7th of a wavelength in order to have an impedance greater than 50 ohms.[1] What a lucky break for 40 meter QRP fans! Can you hang a 40 meter dipole higher than 20 feet when you are out in the boonies with only trees for supports?

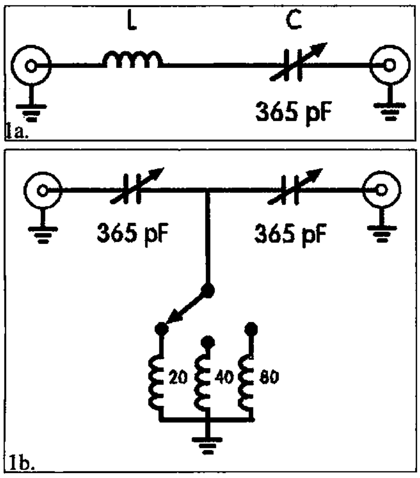


*Fig. 1. Miniature plastic dielectric variable capacitors can be used in extremely compact QRP antenna tuners. The circuit shown in **Fig. 1a** is useful for fine-tuning antennas that are close to resonance. For a wider range of matching use **Fig. 1b**.*

Circuits to try

So far we have only talked about purely resistive loads. What about that nasty thing called reactance? Most antennas have it and it really should be tuned out, which can be done by carefully adjusting the antenna length (usually not practical). An easier way is to insert either a capacitor or an inductor in series with the antenna to cancel its reactance. But how do you know whether you need a capacitor or an inductor? Usually you don't. The answer is to use the circuit shown in **Fig. 1a**. It is useful for fine-tuning antennas which are near resonance. At resonance, the inductive reactance is equal to the capacitive reactance and cancels it, leaving zero. At lower frequencies the circuit becomes a capacitor and at higher frequencies it is an inductor. This is a practical circuit. It can be made from a small plastic dielectric broadcast tuning capacitor (Calectro A1-233) and a toroidal coil. It is great for canceling the reactance of antennas with a radiation resistance near 50 ohms, such as a quarter-wave or a half-wave dipole. The circuit is not, however, an impedance transformer.

If we add just one more miniature 365 pF variable, we can build an impedance-transforming T network (**Fig. 1b**). It will give you a perfect match. This network is the smaller unit shown

at the top of **Photo A.** I used pin jacks instead of UHF connectors for the input and output. When used with my MFJ-9020 it matched 25, 50 or 100 ohms without any measurable loss. However, when I tried it with 18 watts and a 50 ohm load, I lost a watt. Better stick with QRP or the plastic dielectric in the capacitors might melt!

With my 27 watt MOSFET rig I use the circuit shown in **Fig. 2.**[2] The capacitors were borrowed from an MFJ tuner. Band changing is done with a jumper on a double banana plug. It grounds either the 20 or the 40 meter coil. On 80, the 40 and 80 meter coils are connected in series. To complete the unit, I added a VSWR meter using the directional coupler from a burned-out meter. The complete tuner measures only 5-7/8" by 3-1/8" by 3", and weighs just 1.25 pounds.

You may wonder why I chose toroidal coils rather than the higher Q air core ones commonly found in antenna tuners. Well, my home-brew tuner and the MFJ-900 both put out 26 watts into a 50 ohm load. However, for a 25 ohm or a 100 ohm load, the home-brew tuner was the winner by a watt or two. The toroidal cores are available from Amidon.

Oh, one other thing. How come manufacturers persist in packaging their standing-wave meters in massive plastic cases or even heavier steel ones? You can easily build your own and it will weigh less than half a pound. Two examples are shown at the bottom of **Photo A**. On the left is a toroidal transformer bridge (*ARRL Antenna Book*).

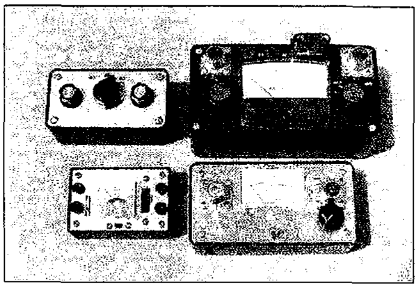


***Photo A.** Very compact antenna tuners can be built using toroidal coils and miniature capacitors. The larger unit is used with my 27 watt MOSFET amplifier. At the bottom are two types of standing-wave meters.*

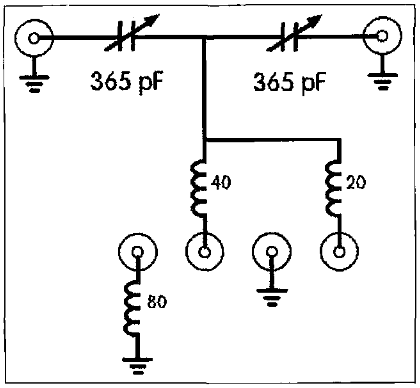


***Fig. 2.** This medium power antenna tuner utilizes air dielectric capacitors. A shorted double banana plug is inserted into jacks connecting coils for the desired band.*

This type of VSWR meter can be very compact. They are, however, a bit tricky to build and adjust. Most commercial tuners use a three-wire shielded transmission line as a directional coupler. Some use three silver-plated rods suspended in a metal trough. Others use three parallel traces on a circuit board. I built the one shown in **Fig. 3** and **Photos A** and **B** using a 6-1/2" length of RG-58 A/U. First I removed the outer plastic jacket. I then opened up the braid a little bit. Next I threaded two lengths of #22 tinned bus wire into Teflon™ spaghetti. I then threaded the insulated wires inside the braid, trying to keep them on opposite sides of the center conductor. The circuit is shown in **Fig. 3.** Be careful to keep the leads to the 1N67A diodes and the 150 ohm

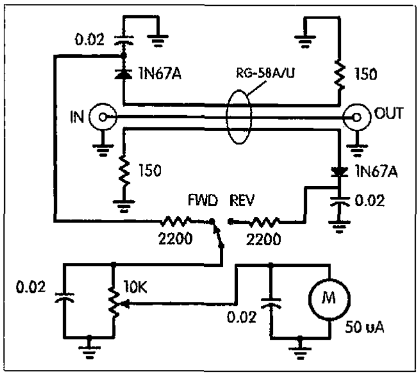


***Fig. 3.** A simple standing-wave meter using an RG-58 A/U directional coupler. The 2200 ohm resistors are RF filters. They also help protect the meter against burnout at maximum sensitivity.*

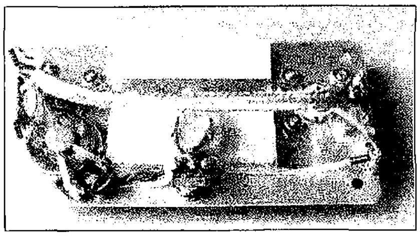


***Photo B.** A modified length of RG-58 A/U makes an ideal directional coupler. If carefully constructed with short leads, no adjustment will be required for a perfect balance.*

resistors very short, as shown in **Photo B**. If you can't find 1N67A diodes, use 1N34A. The RG-58 A/U braid should, of course, be grounded at both ends. I borrowed the calibrated meter from a discarded Radio Shack™ standing-wave meter. If carefully constructed, the result should be a perfectly balanced VSWR meter. It should need no adjustment.

While not absolutely essential, an antenna tuner can be a useful addition to any portable station, especially when less than ideal antennas must be used. This does not mean, however, that the tuner must be a gigantic box. Careful construction can result in a handy compact tuner, and a lightweight standing-wave meter.

References:

1. Terman, F.E., *Radio Engineer's Handbook*, McGraw-Hill, 1943 (curve, page 791).

2. Vreeland, R.W., "Transformerless Amplifier," *73 Amateur Radio Today,* August 1995, pages 48-54.

Parts Sources:

Calectro, GC Electronics Division of Hydrometals, Rockford, Illinois 61101.

Amidon Associates, 10233 Otsego St., North Hollywood CA 91607

Toroid Winding Instructions (all cores from Amidon)

Band	QRP Tuner (Fig. 1b)	Medium Power Tuner (Fig. 2)
80m	22T #20 on T106-6 Core	18T #20 on T106-6 Core
40m	18T #20 on T68-6 Core	19T #20 on T68-6 Core
20m	10T #20 on T50-6 Core	10T #20 on T50-6 Core

Number 23 on your Feedback card

The Topbander

A cheap and easy antenna tuner for 160 meters.

Kenneth Lowrey W8ND
7716 Oceola Lane
West Chester OH 45069

With the current sunspot cycle seriously affecting operations on the high frequencies, the 160 meter band presents some attractive wintertime operating alternatives. It is not plagued with QRM from foreign broadcast stations like 40 meters. The "top band" is not crowded like 75 meters and the operators are more friendly and more accommodating than some of the groups on 75 meters. Some have called 160 the "gentleman's band."

For many years I was under the impression that successful operation on 160 meters required long lengths of wire at high altitudes and miles of radials. However, not many of us can erect a dipole antenna that is 260 feet long—not many of us own the large area of land required for an extensive radial system. The good news is that we can still get in on the fun and action on 160 because none of this special stuff is essential on 160 meters! Granted, if you want to work DX regularly on the top band you would be advised to erect large antenna systems with as much height as possible. You will want to experiment with special receiving antennas, and be sure to include the best radial and ground system possible. However, routine operations such as rag-chewing and meeting your friends on 160 can be very rewarding without going to extremes on the antenna and radial systems. In fact, you can have loads of fun on 160 with just a small amount of effort.

The secret of my successful 160 operation, and the object of this article, is a home-brew antenna tuner which I call "The Topbander." I have worked stations over thousands of miles away with excellent results while running only 100 watts of power into a 75 meter dipole. I even made a contact with a QRPer who was running only 10 watts on SSB! QRP on 160? Yes, fun activities on 160 await you. All you need is a length of wire (it does not have to be a dipole) and The Topbander. The Topbander described in this article can be assembled in just a few hours. An added benefit is that this project is very kind to the wallet!

Construction

This antenna tuner is different from any other that I have seen because it uses no variable capacitors. The capacitors are fixed, and the inductance is variable. There are several reasons for not using variable capacitors. Variable capacitors for frequencies like 160 meters are large, difficult to find, and usually expensive. Large variable capacitors at these frequencies mean a lot of big plates, which require a lot of chassis space and take up a sizable part of the operating area as well. In addition, if you wish to operate with high power, even wider plate spacing is required to eliminate arcing during transmissions; this compounds the size problem. Furthermore, a large

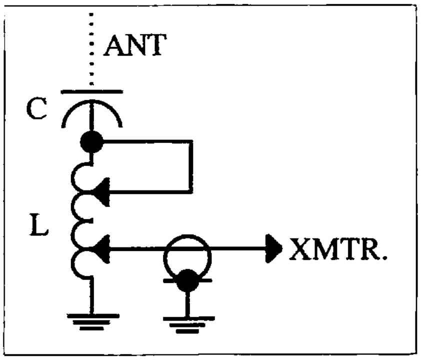


Fig. 1. The schematic diagram of the tuner is a simple series circuit.

antenna tuner looks out of place in today's high-tech, small-size-equipment operating environments. By using inexpensive fixed value capacitors you can eliminate the high cost of variables and build a tuner which is capable of high power operation but is still small in size. My finished tuner is mounted on a piece of wood and measures only 6" wide x 5" deep x 8" tall!

Fig. 1 shows the schematic for the tuner. Talk about simplicity! The components are a home-brew coil and a capacitor bank consisting of a series-parallel network. Start construction of the tuner by winding the coil.

My coil consisted of 40 turns of insulated wire. I used #14 solid copper wire, which is normally used for house wiring. The wire is close-wound, using the insulation as a spacer between turns. Yes, we have been told that power could be lost to the insulation due to coil heating, but this is more theoretical than actual; my coil shows no signs of running warm even after 30 seconds of keydown at 800 watts.

This tuner is designed for a 75 meter dipole with a feedline shorter than 65 feet in length. I have been operating on 160 for some time now with nothing more than a 75 meter inverted vee which is about 45 feet high at the center. In fact, one end is only 12 feet off the ground and the other is only about 18 feet high. The vee is a balanced antenna, fed with 450 ohm ladderline and works all bands from 80 to 10 meters. However, for 160, I short the ends of the ladderline together in the shack and feed the antenna as a longwire. If you have a coax-fed antenna, you can connect the center conductor and shield together and feed it as a longwire. If you use other than a 75 meter dipole, or your feedline is longer than 65 feet, you may need to tap your coil at different turns. In fact, you may have to change the tuner from a series arrangement (**Fig. 1**) to a parallel arrangement (**Fig. 4**) to get a low SWR. In either arrangement, the tuner is still very simple.

My experience has shown that the tap settings may change as the weather changes. Now, do not run to tell your friends that you can predict the weather from reading coil taps! The reason that the coil settings change with the weather is that the 75 meter dipole antenna is electrically short at this frequency. With

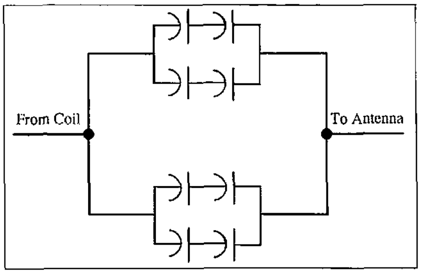


***Fig. 2.** The capacitor bank is a series-parallel network of 470 pF capacitors; total capacitance equals 940 pF.*

electrically short antennas, the higher the ground resistance, the more power is lost. Resistance in soil varies considerably due to changes in soil moisture and temperatures. As a result, variations in the soil conductivity around your ground system affect the number of coil turns needed for a resonant circuit at your location, and the placement of coil taps. So, even slight changes in ground resistance will affect the tuning circuit, such as after a rain or snowfall; the tap positions will also have to be changed as the soil dries during prolonged periods of drought. After a short period of operating under different weather conditions, you will discover where your coil taps should be placed to obtain the lowest SWR. The SWR does not have to be 1:1 to obtain power output. An SWR of 1.2 or even 1.5 may result in full output on 160.

Making the coils

To construct your coil, first cut an 8"-long piece of 2" schedule 40 PVC plastic pipe (note that 2" plastic pipe is the inside diameter; your coil form will be about 2-3/8" outside diameter). Then drill a small diameter hole about 1/2" from each end. Insert a small screw into each hole and slip on an eye-type connector before tightening the connection with a nut. Solder a length of # 14 solid copper wire into one of the eye hooks. Next, wind the wire on the coil form, and solder the other end of the coil to the hook on to the other end of the coil form. The coil should be tight against the coil form, but it may not be as tight as a factory-made coil, and a little "play" is acceptable. I found strips of duct tape to be useful in holding the coil in place during the winding and soldering process.

Several taps will probably be required on your coil. I had to start my taps at five turns from the ground end, and at three turns from the output end. Cutting coil taps in the wire insulation is easy; the secret is to take your time and try not to cut or nick the wire. I used a hobby-type knife to remove the wire insulation for the taps. Make certain that your blade is sharp, and make your cuts *very carefully.* Most hobby knives are very sharp, and you can cut yourself easily. Remember that this is amateur radio, and safety is our first concern.

Place the coil in a vise in a horizontal position, taking care not to crimp or damage the wire. Choose a coil tap point and make a vertical cut along one side of the wire, again trying not to cut or nick the wire. I made my tap cuts about 3/4" in length. At the top and bottom of your vertical cut make horizontal cuts across the insulation to expose the bare copper wire. It is advisable to "stagger" the taps so as not to interfere with adjacent tap points. I used small alligator clips to test the SWR, and when I found the tap positions which gave me the lowest SWR, I connected permanent coil taps. To do this, I used pliers to curl the end of a ring or eye connector, placed it around the bare wire, then crimped and soldered the connector to the wire. Be careful not to solder to the adjacent coil turns. Once the placement for the permanent taps were determined, you can make a new coil by unrolling the old one and using it as a pattern to determine the tap locations on the new wire. This is easily done if you place one end of both

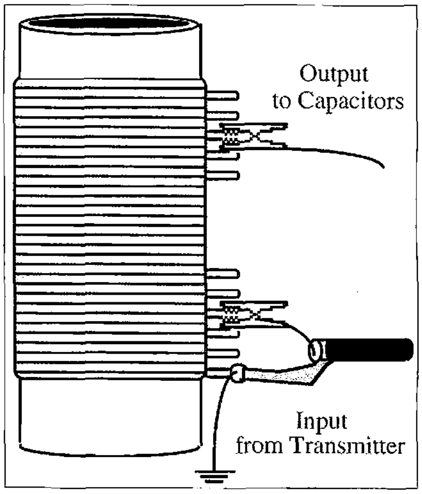


***Fig. 3.** Wiring the tuner is easy. Simply connect one alligator clip from the transmitter to the coil, and another clip from the coil to the capacitor bank.*

wires in a vice. You may decide, as I did, to use your prototype coil as your permanent one. This is OK too, if you did not nick the wire when removing the insulation. Remember that ground resistance changes with soil temperature and moisture content; make a number of QSOs over several weeks with your Topbander under different weather conditions so that you will know how many permanent taps you will need and where these taps should be placed on your coil.

You may choose to purchase coil stock instead of winding your own coil. A good choice would be an 8"-long coil with a 2-1/2" diameter, and six turns per inch.

The capacitor network

Next, build the capacitor network. Note that the capacitors are in a series-parallel network (**Fig. 2**). If you wish, you may substitute other capacitor values in your series-parallel network. If your capacitor values are different, then the number of coil turns required for resonance will also change. The formula for calculating series and parallel capacitance is found in all of the amateur handbooks and in most electronics textbooks. However, if you use the same schematic as **Fig. 2**, and all of your capacitors are of the same value, the total capacitance of your network will be *twice* the value of *one* capacitor in your bank. I used 470 pF capacitors and the total value in my bank of capacitors is 940 pF. Also, you do not need low tolerance capacitors; 20% tolerance is fine. If you have precision-value capacitors in your junk box go ahead and use them if you like, but they are not required for the success of the project.

You will need high-voltage fixed-value capacitors for this tuner. I used 3 kV capacitors in my circuit. My capacitor bank will take 800 watts of power at keydown for over 30 seconds without heating. Mica transmitting capacitors are probably the best choice for this application, but I used disc capacitors because that is what I had in my junk box. I used NPO disc ceramics to keep heat from affecting capacitance values, but NPOs are not required.

If you do not have any high-voltage capacitors in your junk box, there are several sources for them. You could cannibalize an older tube-type television

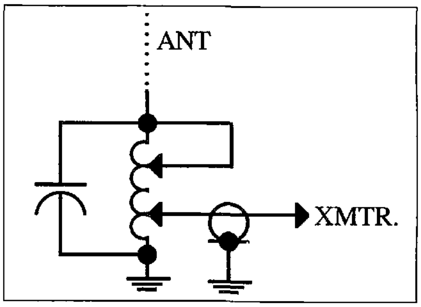


Fig. 4. An alternative diagram for antenna systems with feedlines longer than 65 feet.

chassis. Another source would be the flea market vendors at hamfests. If these efforts are not successful, ask around on the 2 meter repeaters or at your club meetings; sometimes other hams have transmitting-type capacitors in their junk box just waiting to be used. A fourth alternative would be to purchase the required capacitors from a retail vendor; they are usually not expensive. Some surplus dealers sell high-voltage transmitting capacitors. (Radio Shack™ stores generally do not stock high-voltage capacitors.). If all else fails, send me an SASE and I will help you locate the necessary parts.

I built my capacitor bank on a small piece of perforated board which measured about 2-1/2" square. In order to save space, I mounted both the perforated board holding the capacitor bank and the coil vertically on a piece of wood.

The wiring

The wiring of the tuner is very simple. Simply run a short piece of coax from the transceiver to the tuner and connect the center conductor to an alligator clip for the input coil tap (**Fig. 1**). Attach the coax shield and your earth ground to the low end of the coil. Then use another alligator clip for the other tap and connect it to the capacitor bank (**Fig. 3**).

Connect the output from the capacitor bank to the antenna, and feed it as a longwire. If you have a feedline longer than 65 feet, connect the capacitor bank *across* the coil (**Fig. 4**). Adjust the taps for the lowest SWR and you are in business with The Topbander!

If you want to do some very enjoyable hamming with low QRM during the wintertime, without huge antennas and without huge outlays of cash, then 160 and The Topbander are for you.

Build the Turbo Digi-Sniffer

A quick, cheap and easy digital field-strength meter.

Dave Pelaez AH2AR/5
7309 Centenary Dr.
Rowlett TX 75088

Whether you are involved in foxhunting, testing actual antenna performance or "sniffing out" leaky transmission lines, a sensitive field-strength meter (FSM) is an excellent addition to the ham shack.

The heart of this digital FSM utilizes an already-assembled liquid crystal digital display that has become available through numerous sources/distributors. I initially found one of these displays at the Dallas hamfest. Originally, the reason for buying the display was to use it in another application as a digital frequency readout for an amateur television downconverter. However, once I examined the display, I immediately recognized its potential use as a digital FSM. I returned to the hamfest the following day to get the name of the distributor, and much to my disappointment, couldn't find the guy who had been selling them—he must have packed up early.

Several months later I was in the Dayton, Ohio, area, and rediscovered another source for these displays: Midwest Surplus Electronics. I checked with the store owner and he verified that he had a reliable source for these displays, and Midwest Surplus also had all of the parts called for in this "Turbo Digi-Sniffer" article. (See the toll-free number and address at the end of the Parts List.)

The display

Described as a 3-1/2-digit LCD panel meter, the display is manufactured in Korea. The model number is listed as "PM-128." The panel meter comes already assembled and uses a dual-slope integration analog-to-digital converter circuit. It has a sample rate of three readings every second. The maximum voltage that can be measured with this display is 500 volts; this can be done by simply changing the value of two resistors. The display can be set up to read at the microvolt level so it can become the main building block for a digital field-strength meter.

Construction: digital panel meter modifications

The panel meter circuit board's silkscreened pads show a pair of pads marked "RA" and "RB" (see **Photo B**). The 1 megohm potentiometer that will

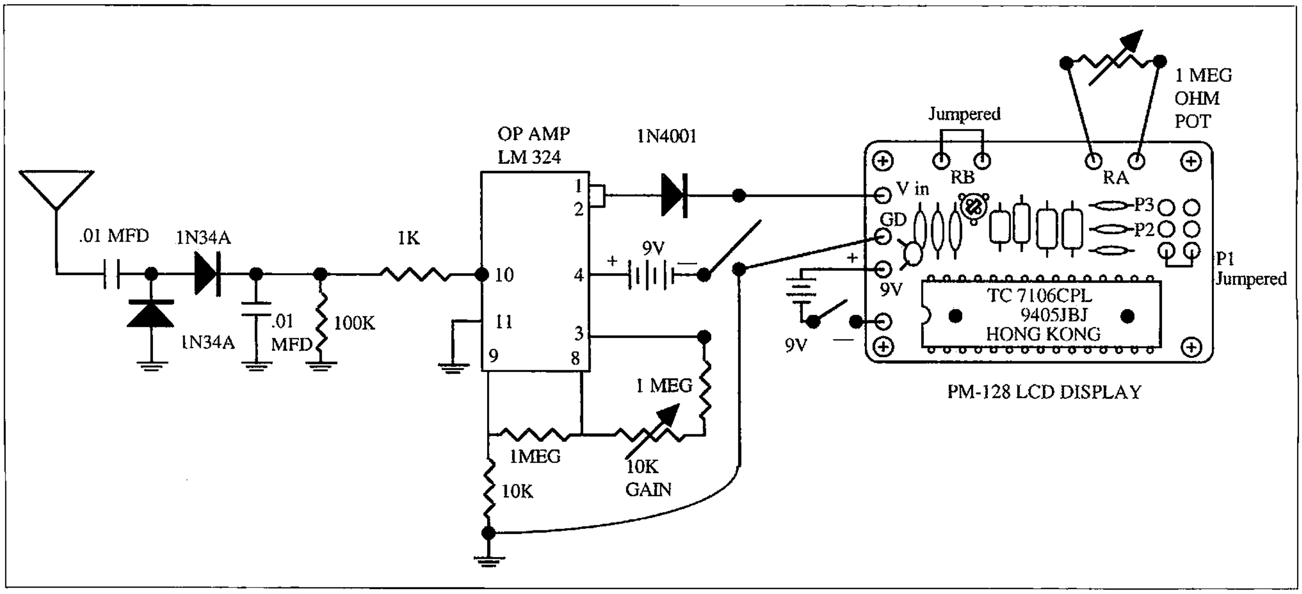


*Fig. 1. Schematic for the Turbo Digi-Sniffer. When using this circuit with the LCD display, the display and this circuit **must** have separate 9 volt power sources.*

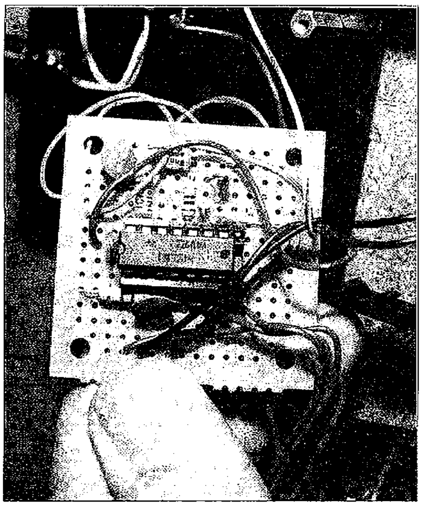


Photo A. The op-amp voltage multiplier circuit used in the Turbo Digi-Sniffer. Point-to-point soldering using perf board was the selected method of construction. Lead length is not critical.

be accessible from the front of the Turbo Digi-Sniffer should be connected to the junctions at RA. The potentiometer will now allow you to change the displayed voltage sensitivity. The junction pads at RB should remain jumpered together. The two P1 junctions also need to be jumpered together. The P1 modification sets the decimal point on the display as (.000).

Construction: the rectifier/voltage multiplier circuit

The rectifier/voltage multiplier circuit portion of this project has appeared in many electronic "recipe books." Aside from containing a passive rectifier circuit, it also contains an operational amplifier (LM 324) which is employed as a voltage multiplier. When coupled with a digital voltage display sensitive to microvolts, the display will be able to essentially detect voltage in the picovolt (billionth of a volt) range. This particular project will require two 9 volt batteries. As the op amp section is an active circuit design, it will require a 9 volt power source. The LCD display will also require an additional and separate 9 volt battery. Both of these batteries are connected through the DPDT switch. The LCD panel display pulls less than a milliamp of current, and because of this low current drain on the battery the display battery will last a year or more with normal use.

I elected to mount the rectifier/voltage multiplier circuit on some perfboard and point-to-point soldered this circuitry, populating the board by surrounding the 14-pin IC socket with the listed components. The actual circuit layout is noncritical, and the mount-and-solder method of placing the circuit components on the perfboard does not have to follow any particular order as long as it follows the schematic layout. Since I had a number of different types of antennas configured with a BNC, I chose to use one of the junque box chassis-mount BNC connectors I had. A UHF-style connector or even an RCA-style chassis mount connector would work fine as a way to connect an antenna to the Turbo Digi-Sniffer.

Once the rectifier/voltage multiplier circuit is complete, connect it to the digital display board. As a matter of interest, you can keep the cost of the project down by using junque box parts. Any germanium diodes will work (some may work better than others). The value of the RF choke and the capacitor also are not critical within the rectifier circuit. The aluminum chassis pictured was purchased at Midwest Surplus for $1.95. The Turbo Digi-Sniffer acted a little erratically when originally built into a plastic enclosure, possibly due to capacitive coupling with the hand and the tendency for RF to take other paths past the diode and choke. An aluminum chassis will rectify this situation. The most difficult part of this project was "hogging out" the window on the aluminum chassis for the digital display. The most time spent on this project was in preparing the chassis. It took less than an hour to solder the components and leads in place!

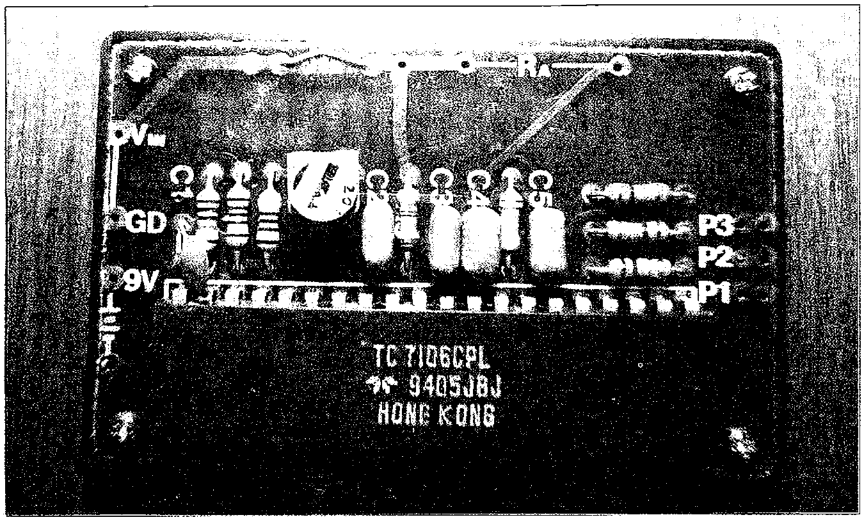


Photo B. Back of the LCD display, showing the silk-screened layout pads for the described hookup.

The smoke test

For initial alignment, the panel meter has to be on and you will need access to the 10k trimmer and the 10 megohm chassis-mounted potentiometer. You may need to go back and forth between the trimmer pot and the chassis-mounted pot to get the initial alignment in the ballpark. Try starting with a rubber-duck-sized antenna on the Turbo Digi-Sniffer and an RF source, such as a signal generator. Without a signal generator you could use an off-hook cordless phone or baby monitor. If the field is too strong for the counter to resolve or if the gain control on pins 8 and 3 of the LM 324 is too high, the display will go into an over-range condition, displaying the number 1, with no other digits. The chassis-mounted 1 megohm potentiometer controls the sensitivity of the LCD display, while the 10k trimmer controls the gain level of the voltage multiplier circuit. With the gain all the way up on the potentiometer, you will see that you will be able to adjust the 10k trimmer at the LM 324 to a level where there is a zero reading with no antenna connected to the Turbo Digi-Sniffer (with no nearby RF sources), but with an antenna connected the display will start detecting "far-off" RF sources. Be aware that these far-off sources may be a local AM or FM radio station, and the LM 324's gain control can attenuate these very weak signals. After proper adjustment, the display should read .000 with no RF field present. A nearby RF field will cause the display to show digits; the stronger the field, the higher the number displayed.

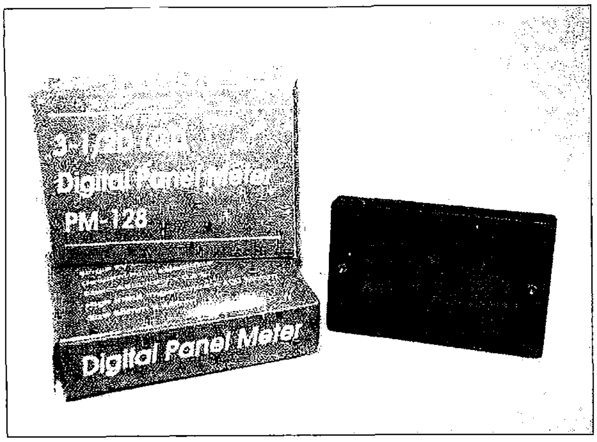


Photo C. Pre-built LCD with analog-to-digital converter.

Let's experiment

I've found that the Turbo Digi-Sniffer is sensitive throughout a wide range of frequencies. Also, keep in mind that different types of antennas on the Turbo Digi-Sniffer will also affect sensitivity at different frequencies. As this device is not calibrated, the emphasis should be placed on "relative" (in relative field-strength readings). Relative readings are extremely useful when checking out antennas or when out in the field sniffing for foxhunt transmitters. Do you want a really big scare? Try checking out your microwave oven using the Turbo Digi-Sniffer. Yes, Virginia, microwave ovens do leak!

When using the Digital FSM to detect RF fields, insure that the measurements are conducted at least two wavelengths from the transmitter antenna. Also remember to keep the Turbo Digi-Sniffer's antenna at the same orientation (polarization) as the transmitter antenna. Note that the metal chassis and the Turbo Digi-Sniffer antenna, if brought into an optimum plane, can become coupled with the transmitter antenna and become a part of the radiating system. Talk about some wild field-strength readings!

A perfect club project?

The cost of all the parts of this project can be kept at about $20 with careful shopping, and the Turbo Digi-Sniffer design is both simple and practical. What's stopping you, then, from organizing a club project one Saturday morning and putting together a barrelful of these useful test instruments for all the club members? 73

Parts List

Qty.	Part #	Description
1	29-01	LCD panel display
1		1 megohm potentiometer (chassis-mount)
1	4" x 2" x 2-3/4"	Aluminum chassis
1	RF-114	BNC female chassis mount
1	LM-324	Quad op amp
1	1N4001	Diode
2	1N34A (or equiv.)	Germanium diode
2	CD111	.01 µF disc cap
1		1k ohm 1/4 watt resistor
1		10k ohm 1/4 watt resistor
1		100k ohm 1/4 watt resistor
2		1 megohm 1/4 watt resistor
1	VR207	10k ohm single-turn trimmer pot
1	ICS2	14-pin IC socket
1	570-21	Mini chassis-mount DPDT toggle switch*
1	JALPC-1	Perf board (you cut to size)
2		9V battery connectors

Note: All parts can be ordered from Midwest Surplus Electronics, P.O. Box 607, 501 W. Main St., Fairborn OH 45324; (800) 523-3690.

* DPDT chassis-mounted switches are available at Midwest surplus, so they are used here in lieu of the DPST (double-pole single-throw) switch used to switch on and off the two 9 volt batteries. The double-throw portion of this switch is not used for this project.

Photo D. The completed Turbo Digi-Sniffer.

Number 30 on your Feedback card

Sumas Mountain High

Building a self-sufficient repeater tower on a British Columbia mountain.

Will Imanse VE7BID
211-33370 Nelson Ave.
Abbotsford BC
Canada V2S-2L8

In the center of the 80-mile-long Fraser Valley in British Columbia, Canada, sits 3,000-foot-high Sumas Mountain. This hill is situated perfectly to give a clear, unobstructed view that stretches (from west to east) from the east coast of Vancouver Island almost all the way to the town of Hope, and southward into the United States to well past the city of Bellingham, Washington.

Several years ago the hams of Abbotsford BC, at the base of the mountain, dreamed of putting a repeater on Sumas. Our dream has finally become a reality.

We chose a site on a ridge at 2,750 feet. The Fraser Valley Amateur Radio Emergency Services Society applied for a government lease and was approved. Next came the challenge: Building and running a repeater site with no available power in the foreseeable future and very limited vehicle access.

The designers decided to use solar power; later we added wind power. The British Columbia Telephone Company donated a 50-foot tower in return for a small donation to the Telephone Pioneers of America Society. A donation of cinder building blocks from the local Blackwood Building Supply and Home Hardware store helped, too. One of the local hams, an experienced bricklayer, was put in charge of constructing the building. Another ham with cement experience (and a truck for the job), took care of the cement work and getting the materials to the site. The tower work was done by a ham who worked in the tower construction field. Teamwork and cooperation from a number of other hams helped create a professional-looking site. A small solar-powered commercial site not too far from ours looked *amateur* by comparison!

***Photo A.** Storms are common up here, so the guys are heavy-duty.*

We erected the 50-foot tower next. We drilled down into the stony mountainside three feet in four places for the base and epoxied threaded steel rods into the rock. The tower was then put into position, with a 20-foot-diameter H fixture installed at the top for the antennas. The vertical pipes at the end of the H fixture were extended above and below for both upper antenna and lower inverted antenna mounting. This allowed for eight antennas to be mounted on the tower without having to mount them on the face of the tower itself. We also added an anti-climb shield and gate to keep unauthorized visitors off the tower.

The tower was supposed to be self-supporting, but with the amount of weight at the top we decided to add guys. As you can surmise from **Photo A**, the mountaintop winds can be fierce.

Next, we added a donated chain link fence, then a second tower—an 80-foot guyed tower, donated by the local Rogers Cablevision outlet. It was also installed with two H fixtures, providing room for six more antennas. With some more small donations to the Telephone Pioneers, we obtained some antennas and heliax waveguide.

The main VHF repeater is on 146.60 MHz and the UHF repeater is on 442.025 MHz. We also have a packet repeater, a full duplex UHF link for phone patches to Abbotsford, and a 1.2 GHz FM amateur television repeater with two remotely-controlled cameras, mounted on the two towers. These cameras can be tilted and panned by tone control. They allow us to check conditions and monitor any intrusions at the site. They also allow fantastic views up and down the valley. An outside speaker and microphone can be activated remotely to communicate with people at the site. A planned motion detector with announcement on the VHF repeater will also alert us to any intruders.

All the equipment runs from 16 solar panels at the site. Eight are located on the roof of the building; the other eight are on one tower. The panels on the tower can be for winter and summer sun angles.

We've tried a number of windmills, but so far four of them have self-destructed. The first, a 75 watt model, lasted a few months. The next three were 300 watt models. One lasted less than a day, and another less than a week—and that after the manufacturer assured us that they were almost indestructible. The current 300 watt model is still running—we're keeping our fingers crossed.

At the same time, we also put up a 55-foot self-supporting tower in the town of Hope, 50 miles to the east. A VHF repeater at 147.08 MHz was installed in a cabinet on the side of the tower. Now we're working to link the Abbotsford and Hope repeaters, and then expand farther east via links into British Columbia's interior.

We're proud to have built such an impressive repeater site. Our group has solicited all the donations to the cause, and in some cases donated our own equipment and funds. The cooperation among the group of amateurs that took on this project was first rate. There was seldom a problem securing volunteers for a work project. *This* is what amateur radio is all about. 73

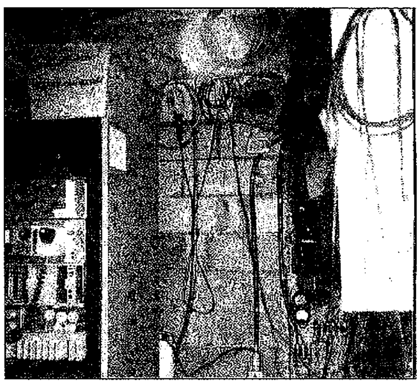


***Photo B.** Keeping some spare cables and other items on hand helps. The main and secondary 2m repeaters are visible on the left.*

third the cost. With the number of government employees now outnumbering our manufacturing force, it does tend to make everything we let the government buy for us cost at least three times normal. And that's on a good day.

If Congress would allow competition, we'd have private mail services providing two deliveries a day, with first class mail for 10¢, according to expert estimates. If you'd like to get really upset over our mail service, read *Monopoly Mail* by Douglas Adie, Transaction Publishers, Rutgers University, New Brunswick NJ 08903, ISBN 0-88738-747-0, 197p.

As long as you're content to work the first four hours of every day for the government and the rest of the day for yourself, the situation is just going to get worse. Yes, the government comes first. They get your money without your ever even seeing it.

What can you do about the mess? Well, I've already explained that. Let me boil it down for you. 1. Never re-elect anyone. Keep flushing the political toilet. And don't re-elect anyone ever again in the future. We don't need to worry about term limits if you'll flush the toilet every two years. 2. Let's get some hams into our state legislatures.

Justice

A letter from a reader mentioned that the medical industry scams are at least matched by our criminal justice system. I love the euphemism. Justice system, indeed. And how about our "correctional facilities"? That's about the last thing they do. Anyway, Leigh writes, "They don't care who's guilty, they just need convictions, and they need to keep the minorities stirred up just for job security. They will gladly send an innocent person to prison to further their careers. I'm told that Sandra Day O'Connor made it to the Supreme Court on cases where the evidence was manufactured by a crooked lab that used to operate in Phoenix. After their methods were discovered they closed shop and moved their business to Texas, but very few cases were retried as a result."

Surely Leigh must be exaggerating. No American would ever do anything like that, would they? For some reason that reminds me of when I was a TV producer-director and I got to know a New York City police detective who wanted to blow the whistle on what was going on. For instance, he told me about a cooperative dentist just down the street from the station house where they'd take prisoners. The dentist would drill the guy's teeth with no pain killer, right down into the nerve, one after the other, until he signed a confession. The dentist would then fill the teeth and nobody could prove anything. He said they always got confessions. The exposé program we were planning fell apart when my friend suddenly disappeared. He's never been heard of again.

I also remember my first court case in New York. I had a simple open and shut case, but my lawyer said I would have to give the judge $5,000 if I wanted to win. I didn't see how there was any way to lose so I didn't pay. I lost.

Then there was the time I was a witness in a murder case where I had critically important testimony to give and was not allowed to give it. The murderer got off with a slap on the wrist. So much for swearing to tell the truth, the whole truth, and nothing but the truth. Not in *our* courts.

There sure are a lot of things we need to fix to make this the country it could and should be.

Though I've had millions stolen from me, with no punishment for the thieves, I'm still optimistic. Heck, I can always make more.

Have you had any interesting experiences with our "justice" system?

AIDS, HIV, and Other Baloney

Yes, I've been reading again, and it wasn't the new *ARRL Handbook* either. Unless you know someone with HIV or AIDS (or both), or are curious about all the fuss, you may not be interested enough to go out and buy the new Peter Duesberg book, *Inventing the AIDS Virus*. It's a $30 722-pager and it nails the medical establishment to the wall for the mess it's made of this whole business.

Since I've read in several places that there are thousands of AIDS patients who are HIV negative, and millions of HIV positive people with no sign of AIDS, Duesberg's claim that AIDS is a lifestyle disease, particularly involving the use of recreational drugs, makes sense. He further provides exhaustive proof that AZT, which is a chemotherapy used to treat AIDS, actually is responsible for causing AIDS. He also provides proof that AIDS is not in the slightest infectious.

AIDS is actually the result of a toxic buildup from drug use. Remember the drug culture of the '60s? Well, is it really all that surprising that people's bodies eventually reacted a few years later? And since drug use is particularly rampant in the homosexual culture, this explains why the syndrome hit this group so strongly. It's similar to cigarettes, where it takes a few years of poisoning one's body with nicotine and tars before emphysema, heart trouble, lung cancer, and other illnesses caused by defeating the body's immune system inevitably appear. These drugs lower the effectiveness of the immune system, allowing any opportunistic disease to win out.

Our bodies harbor billions of microbes. Indeed there are more microbes than cells in our bodies, so our immune system is in a constant war with invaders. Anything that tends to lower the immune system can allow the bad guys to win. Our immune system suffers when we are stressed, when our bodies don't get the required nutrients, if we shortchange it on water or oxygen, or load in toxins.

Continued on page 40

Add a Microphone Preamplifier to Your 10 Meter Rig

Low-cost speech processing can increase your power.

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

Over the past few months I've been playing around on 10 meters. Ten meters *does* open up even in these days of low sunspot activity, and due to the large number of Novice and Tech-Plus hams, there is enough activity on 10 meters that it's pretty easy to know when band openings do occur. Also, there are some tremendous bargains available in 10 meter rigs. The Uniden, Ranger, Lincoln, Emperor, and Radio Shack 10 meter rigs are showing up at very good prices (I guess the folks who bought them during the sunspot maximum are dumping them because they think 10 meters is dead most of the time).

I currently own both a Uniden HR-2600 and a Radio Shack HTX-100. (I know, I know—why do I need both a Uniden 2600 and a Radio Shack HTX-100? Well, we have two *cars!* See how easy it is to justify multiple rigs?) Anyway, when running some tests on these radios, I saw a very distinct average output power variation between these rigs. On my analog power meter (Diamond SX-1000), average talking power is around 5-6 watts on the Radio Shack HTX-100 and only about 1-2 watts on the Uniden HR-2600. Looking at the S-meter on my test receiver (my Icom IC-706), I saw a 2(!) S-unit peak difference in favor of the Radio Shack radio. With both the Radio Shack and Uniden radios, I could whistle-up the power to the advertised 25 watts output; however, the Radio Shack rig did a much better job of keeping the "talking power" up. Hmmm. So what could I do to my Uniden to make it better?

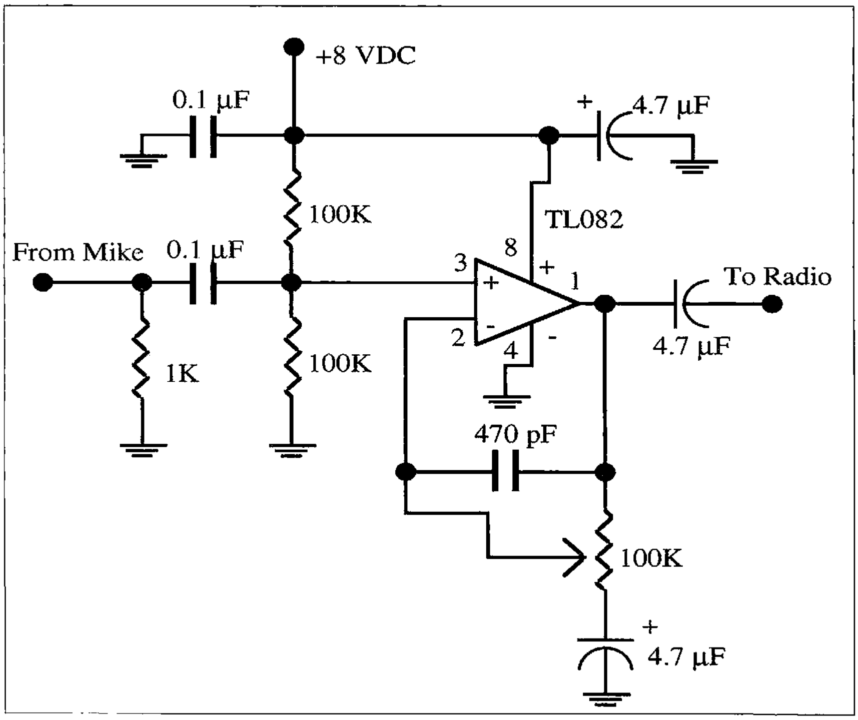


Fig. 1. Dynamic microphone preamp.

"Up" your talk power

After examining the Uniden 2600 schematic (with a magnifying glass—it is small!), I determined that there is no obvious microphone gain adjustment in the radio, so I decided to build in a microphone preamp that would give me equivalent "talk power" to the Radio Shack rig. My final circuit is shown in **Fig. 1**.

I selected the RC values to give around a 300 Hz high pass, and a 3,000 Hz low-pass cutoff. I traced the Uniden microphone connections to the main board (red and black wires), cut the red (hot) wire and inserted the circuit shown. For powering, I probed around on the PC board until I found a source of 8 VDC (regulated) and ground and tapped into these points.

Then, while talking into the microphone, I adjusted the potentiometer for the same 5-6 watts average power as seen on the Radio Shack rig. I also listened to my voice on my IC-706 and verified that there was no distortion. My final tests occurred on the air. Comments from stations I worked included "excellent audio" and "good crisp modulation." I highly recommend the addition of this preamplifier circuit to your Uniden radio.

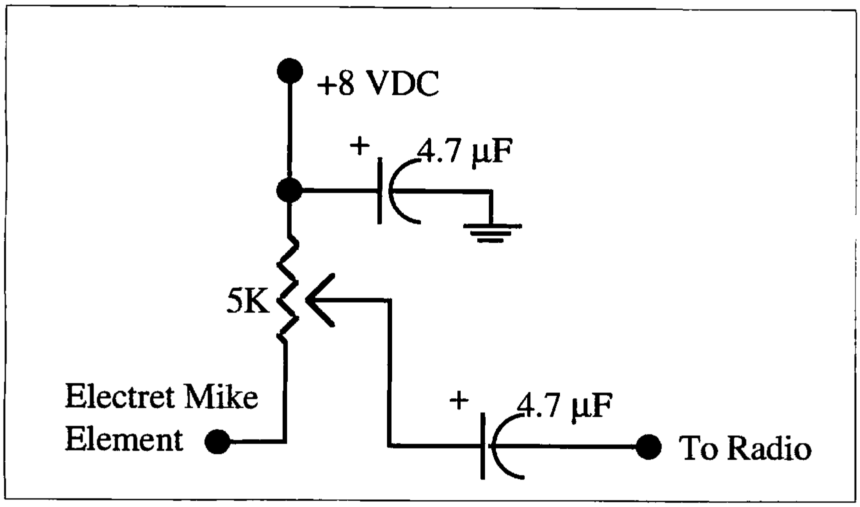


Fig. 2. Electret mike element powering.

Change the mike element

A friend of mine, Bob N5UPF, owns a Uniden 2510. This radio had a dead microphone. Since the Uniden 2510 and 2600 share the same microphone, I borrowed Bob's radio to check the "average" power and found it to be similar to that of my unmodified HR-2600. I also verified that Bob's microphone element was dead. Finding a replacement dynamic microphone element for this microphone is difficult, and dynamic elements are relatively expensive. Since Bob's 2510 could benefit from increased microphone gain, I decided to substitute a Radio Shack electret microphone element for the dynamic element. These electret elements are very small, inexpensive, easily obtainable, and they have gain.

Unfortunately, these mike elements also require powering—but this turned out to be a pretty easy fix. First, I stuffed the new tiny electret element into Bob's microphone case, added a drop of epoxy to hold it in place, and then packed a piece of foam rubber behind it to fill the large cavity left by the dynamic element. Next, I traced the microphone wires into the radio. The hot wire turned out to be a yellow wire in a large, connectorized bundle of wires. I cut this yellow wire and inserted the circuit shown in **Fig. 2**. Again, I probed around on the PC board to find a source of regulated 8 VDC and ground. Anyway, when everything was finished, I ran my "average" power tests while adjusting the potentiometer so that Bob's 2510 put out the 5-6 watts of the HTX-100 and my preamplified HR-2600.

Since I completed the above projects, my HTX-100 microphone failed. What *is* it about these dynamic elements? Anyway, I built the same electret element and powering circuit as shown in **Fig. 2** into my HTX-100. In the HTX-100, the front panel circuit board uses solder bridges to attach to the main circuit board. I probed around on the solder bridges until I identified the microphone "hot" wire, removed the solder bridge, and substituted the **Fig. 2** circuit across the gap. An adjacent solder trace had the 8 VDC I needed for powering the mike element. Again, I adjusted the potentiometer for the 5-6 watts average power output on my analog power meter.

Some radios can probably benefit from increased mike gain—I know the Uniden radios do. It is pretty easy to build a microphone preamp or replace a dynamic mike element with an electret mike element. Since the Uniden radios use ALC to limit the maximum transmit power, we are effectively getting some audio speech processing due to the combination of additional microphone gain and ALC limiting. Finally, both of these circuits are physically small and easily fit inside most any radio. Now if 10 meters would just open up a little more often!

Number 34 on your Feedback card

Hamtronics RWX Storm Watch Weather Broadcast Receiver

Hams need to know about storm emergencies.

Dean Lewis WA3WGV
1193 Azalea Lane
Palatine IL 60074

The NOAA Weather Radio (NWR) broadcast system transmits on seven discrete 25 kHz-spaced frequencies between 162.400 and 162.550 MHz from over 425 stations covering all 50 states, adjacent coastal waters, Puerto Rico, the U.S. Virgin Islands, and U.S. Pacific Territories. The system currently covers 70 to 80 percent of the U.S. population; the current expansion program will increase coverage to 95 percent. NWR has been designated as the sole government-operated radio system to provide direct warnings for both natural disasters and nuclear attack, with plans to include warnings for all hazardous conditions that pose a threat to life and safety, both at a local and national level.

The Hamtronics model RWX is a highly sensitive and selective, professional quality seven-channel crystal-controlled double-conversion FM superhet receiver for the 24-hour NWR broadcasts from the National Weather Service (NWS). You can listen to the current weather report and forecast at any time; or, when set to "Storm Watch," the receiver will remain silent until it receives an alert tone from the transmitting station, opening the squelch so the user can hear the emergency information that follows. Crystals for all seven NWR channels are supplied.

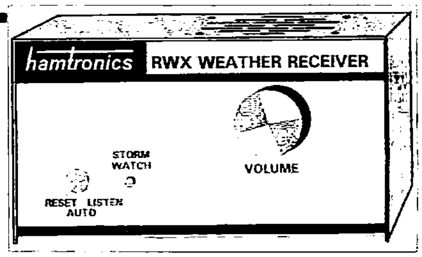
The receiver provides room-filling volume at less than a quarter turn of the front-panel control, so there's plenty of reserve for noisy locations, mobile use, or to hear alarm-activated announcements in another room. Circuit board terminals are provided for an external speaker. Sensitivity and selectivity are excellent. For all the audio volume and features, the assembled unit is a convenient size. The alarm output can be used, through a relay, to drive secondary alarms for those with special needs: a loud bell, flashing light, bed-shaker, etc. In its full kit or assembled form, the receiver comes with a high quality plug-in-the-wall power supply. For temporary portable use it can be powered by any source from a car cigarette lighter to 12 volts worth of AA cells, or a 9 volt battery. Watch battery polarity carefully.

> ***"The Hamtronics model RWX is a 'must have' for hams or for anyone else involved in or affected by emergency operations due to weather."***

The RWX is available in kit form, with or without the cabinet/speaker/AC power supply, or fully assembled, tested, and installed in the enclosure. Appropriate assembly and/or operations manuals are supplied with the radio in either case.

Circuit description and assembly

RF input at 162 MHz is amplified by a low-noise dual-gate FET. Double-tuned circuits provide rejection of images and out-of-band signals. The first mixer converts the 162 MHz input to the first IF frequency, 10.7 MHz, which goes through a ceramic filter on its way to an integrated circuit IF amplifier. The injection signal for the first mixer comes from a 16 MHz oscillator controlled by



the seven switched frequency systoles. The signal is tripled twice, with double-tuned circuits in each tripler.

The IF amplifier chip contains a crystal-controlled 10.245 MHz oscillator, the second mixer with an output at the second IF frequency (455 kHz), a narrowband ceramic filter, and a quadrature detector. The IC audio output is applied through the volume control to an IC audio amplifier chip, which supplies both the internal and external speaker terminals on the circuit board.

The IF amplifier chip also provides the tone alert squelch function, responding to the 1050 Hz NWS-transmitted alerting tone.

Like their RWWV receiver (see review in *73*, December 1995), the circuit board is FR-4, double-sided, with a continuous ground plane on the top surface; all holes are drilled and plated-through.

Follow the detailed assembly instructions carefully; the suggestions and clues are invaluable for getting good results. As in any VHF circuit, short leads are important. This is a quality circuit board; the parts all fit well, holes are properly positioned, and components solder in easily.

Following the assembly, an RF signal generator and a sensitive DC voltmeter are needed for alignment; full step-by-step instructions are included. Tables of test voltages are provided; if you can build and align the receiver, you can troubleshoot it if necessary. In case you

move or take the receiver to other locations, make a copy of the "Switch Position vs. Channel Frequency" list from the instruction manual and tape it inside the receiver.

Performance

A seven-position DIP (dual inline package) switch, or rather, set of switches, selects the crystal-controlled frequency. The switches are mounted on the circuit board, and are easy to operate with a small straight-blade screwdriver. With the frequency selected and the receiver closed up, only the necessary controls are available on the front and rear panels: volume control, Reset/Auto/Listen switch, a Storm Watch LED, and the BNC antenna connector.

Operation is straightforward. To listen to the current broadcast, set the front panel switch to "Listen." Pushing the switch all the way to the left and releasing it puts the receiver in "Auto" mode and turns on the Storm Watch LED. The radio will remain silent until it receives an NWS-broadcast alert tone. The tone opens the squelch and activates the audio at your pre-set volume.

The quality 12 VDC plug-in power "brick" supplied with the receiver provides hum-free reception.

The BNC antenna fitting is mounted on the rear panel; get a right-angle adapter for mounting an antenna right on the radio. From my location northwest of Chicago, a quarter-wave whip on the back of the receiver provides loud/clear reception of the NWR signal off the Sears Tower, 28 miles away (but then, so does a 3-inch length of wire!). The whole idea, of course, is reliable reception of your local NWR station, but I couldn't resist trying a little DXing. On a warm afternoon, with tropospheric propagation helping out, the following came in clear and strong with a 2 meter AEA "Hot Rod" antenna (telescoping end-fed half-wave), indoors: Rockford, IL (54 mi.); Milwaukee, WI (65 mi.); Grand Rapids, Michigan (140 mi.); Adams, Wisconsin (160 mi.). (Consider the additional value of the NWR stations as 2 meter propagation beacons!)

If you're located anywhere near an NWR transmitter, you should have no problem with a small indoor antenna. In more rural areas, try an outdoor ground plane, or even a vertical yagi. RadioShack™ carries a line of "scanner" antennas that should work well; amateur 2 meter antennas should work just fine.

I've owned weather receivers before. Some have been good for little more than modification to monitor local 2 meter repeaters, some have had serious intermod problems, and most have lacked sensitivity. This is my first that could be called a serious, professional-grade receiver, including the tone alert function; it provides a real measure of confidence that important emergency information will not be missed.

Call your local office of the National Weather Service for the local frequency (or just switch through the seven frequencies until you find it), and the day and time of their tone-alert test. Most seem to be on Wednesdays at noon (ours happens to be Tuesdays at 11:00 a.m.). While you're at it, ask for the current location/frequency list bulletin and other information on NOAA Weather Radio they have available. It's a good idea to monitor the tone alert test occasionally, to ensure proper activation of the Storm Watch function.

Conclusion

The Hamtronics model RWX is a "must have" for hams, CAP, Coast Guard Auxiliary, Police and Fire Departments, schools, hospitals, truck and taxi dispatchers, Scouts, outdoors enthusiasts, or anyone else involved in or affected by emergency operations due to weather. It's easy to use, well-built, sensitive, and dependable.

The RWX is available as a board-level kit for $79; board, cabinet, speaker, and power supply in kit form for $99; or fully assembled and tested with the cabinet, speaker, and power supply for $139.

For further information, a catalog, or to order the RWX, write to Hamtronics, Inc., 65 Moul Road, Hilton NY 14468-9535, or call them at 716/392-9430; FAX 716/392-9420.

The Telegraph

A little device that changed the world.

L. VanProoyen K8KWD
8330 Myers Lake NE
Rockford MI 49341

As we approach the millennium in this "information age," we have access to a variety of communication technologies. This is the story of how the forerunner of them all, the electric telegraph, came to be.

The Morse code

Di-di-dah-dah-di-dit—dots and dashes. When you hear the sound, you most likely think of Morse code—right? But did you know that Samuel Finley Breese Morse's original telegraph system was not based on sound at all?

Dating back to the mid 1830s, Morse's original "receiver" was a lot like a chart recorder. It marked patterns of the making and breaking of an electrical circuit at the sending station onto paper tape. The sending station "keyed" the circuit according to an early code devised by Morse, a forerunner of the familiar dot-and-dash code still in use today—and the traditional telegraph key (**Photo A**) hadn't been "invented" yet either.

Only much later, using a modified receiver, clever "operators" learned to recognize rhythm patterns in the receiver's "click-click" sound, and found that they could translate directly from sound to text. This receiver was subsequently refined into the familiar "sounder" similar to that shown in **Photo B**.

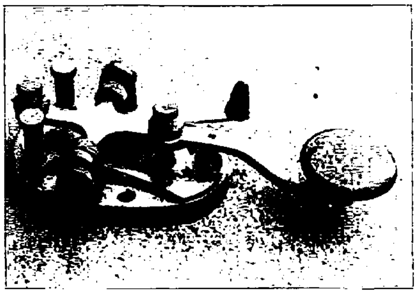


Photo A. The telegraph key.

Morse is perhaps best known for the code that bears his name, but his approach to developing an electric telegraph, pioneering the simplex circuit (one wire pair) and using a quasi-digital signaling code, was unique. It made building a telegraph system possible and led to the communications systems we use today.

Following early trials, Morse's telegraph rapidly spread throughout America in the 1850s. Morse code, as it evolved, went on to become a world standard that has lasted over 175 years. As wireless and radio came of age, the merchant marine also adopted the code as its international standard, pretty much assuring the US a position of technological leadership in the field of telecommunication.

"Now closing down continuous watch. Fair winds and following seas with 73s from all of us." With this transmission at 8 PM (0000 Hours GMT), July 31, 1993, the U. S. Coast Guard ended nearly 50 years of continuous watch on 500 kHz, the international maritime distress frequency. On March 31, 1995, the Coast Guard discontinued all other regularly scheduled use of Morse code. Today, there is virtually no formal use of the Morse code by the US Coast Guard or military. Newer technology—satellite communication, ship-to-shore teleprinters, and the like—is said to have made Morse code obsolete.

Technology changes but the need to communicate continues. Today, there are many technological choices, and high speed data systems have great impact on almost everyone's life. Computers, linked by digital data systems, virtually run the world.

Information is readily available. The data highway, Internet, packet webs, cellular phones, and cable are examples. Getting the message is not the problem it was in the '40s (1840s, or for that matter, 1940s). Perhaps knowing what to do with all the available information, differentiating quality from junk, is today's problem.

Standing on giants' shoulders

As with virtually all inventors, Morse didn't start in a vacuum! In the 1830s, many dreamed of building a telegraph, and some already had telegraph schemes on paper. By the time Morse started developing his ideas, a few others were well underway in perfecting theirs. Chief among these were Charles Wheatstone and Edward Davy, both from England, and both received British "telegraph" patents by 1837.

Wheatstone, now known largely for the Wheatstone Bridge, was an electrical experimenter in the 1830s. He gained early notoriety designing a method which rather accurately measured electrical propagation speed through wire in 1834. The system used a rotating mirror scheme similar to the classic Michelson velocity-of-light experiment.

Wheatstone went on to develop his telegraph over the following years. It initially used five circuits, each terminated with a galvanometer-like device (**Photo C**). Each such device had a pointer that could assume any of six positions according to the current level in its circuit, and with five circuits, Wheatstone could communicate 30 characters—albeit very slowly. Because of the five-line requirement and message coding/decoding difficulty, it was doomed to failure as a practical telegraph system. However, Wheatstone's galvanometer detector would later be modified to use a mirror as the indicator and find application in the first Atlantic telegraph, but that's another story.

Later, working together with William F. Cooke, another telegraph inventor of the time, Wheatstone refined the design to require only three circuits and indicators. This basic system would find early use in England and parts of Europe.

Edward Davy also received a British telegraph system patent in 1837 because of a couple unique features his system had. It was a multi-wire device like Wheatstone's and Cooke's, but Davy designed a repeater circuit which in itself would find later use by others in relaying signals over long distances.

In Germany, experimenters made an early discovery that would also be of use to later telegraph builders. They discovered that a single wire could be used in a (telegraph) circuit if the earth were used to complete the circuit pair (one leg grounded at each end of the link). This discovery was not generally known until after 1837, so Morse did not make use of it initially. Also, Morse's first major test link was begun using an underground line which would have been difficult to insulate, given the state of wire insulation quality at the time.

There was another development, in electrical technology which would prove beneficial to telegraph builders—the battery. Until its emergence, most electrical experimenters were limited to using a galvanic cell which produced about 1 volt. John William Daniell, an Englishman, discovered that cells could be connected in series to form a battery. The increased voltage available from such a battery would solve many problems caused by wire resistance and other circuit losses in telegraph lines. Keep in mind that while Georg Ohm had already formulated his "Ohm's Law," these principles were still a mystery to most electrical experimenters of the time.

America's Joseph Henry was another contributor to the telegraph's development by providing advice and theory on electromagnetics. Since most of the contending electric telegraph systems employed some sort of electromagnetic receiving device, the emergence of sensitive and efficient electromagnets solved a major problem impeding the development of long lines.

There were many more contributors whose ideas were "borrowed" and used in the development of the electrical telegraph.

Putting all the pieces together

Exactly how Morse acquired the various pieces of technology needed to produce a functional cross-country electric telegraph has long been debated. His early notes, for example, indicate he had a basic knowledge of electromagnetic devices. How he acquired this knowledge was the basis of a lawsuit brought

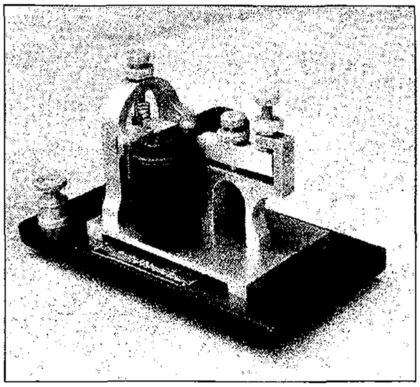


***Photo B.** The sounder as shown was used in telegraph offices beginning in the second half of the nineteenth century, and many were still in use through the 1930s.*

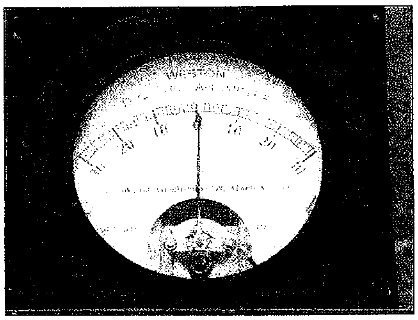


Photo C. *A modern version of the galvanometer. Used today as a laboratory instrument, its development was one of the earliest examples of converting an electrical current into mechanical motion.*

by one Dr. Jackson, a fellow passenger on a ship carrying Morse across the Atlantic in 1832. Morse had been traveling in Europe, purportedly trying to further his career as an artist. It is generally thought that until his trip back to the United States, Morse didn't know what a telegraph was—but by the time the ship docked, Morse had compiled fairly complete design notes which he subsequently used in building his first telegraph. Jackson, a chemistry professor and amateur electrical experimenter, would later claim the telegraph idea was his. One of the many mysteries of technology. I suppose there are other examples, but in researching the history of electrical communications, I was surprised by the number and the ferocity of the legal battles associated with it!

Morse, though well educated, always had a tough time earning a living, compounded by the burden of raising his children alone, his wife having died quite young. This, coupled with living an artist's life, made him quite familiar with tough times. Had he not known trouble, though, he might not have had the personal fortitude necessary to get through the many ordeals he would face during his telegraph system's initial development.

Things weren't going too well...

In 1835, Morse got a teaching post at the newly organized New York City University as a literature professor. This was fortunate because it allowed him access to some of the university's facilities, and he needed lots of space to set up his equipment and carry on experiments between classes. He also found access to resources and other help unique to a university's environment.

One such resource turned out to be Dr. Leonard Gale, a chemistry professor also at the university, and knowledgeable in electricity. Gale was familiar with the Daniell battery and convinced Morse to try using it. They were to form a lifelong friendship.

Gale also spotted deficiencies in Morse's electromagnet designs and provided him with information about Joseph Henry's earlier work. This lead to Morse's producing electromagnets with many more turns of wire than he had ever before used, resulting in much superior performance.

By 1837, Morse had several hundred feet of wire strung around the university halls enabling him to stage demonstrations and test various improvements. Also in 1837, news of Wheatstone's British telegraph patent was getting around, which prompted Morse to register his work with the US Patent Office.

Actually Morse had received a copy of a letter circulated a year or so earlier by the US Treasury seeking ideas for establishing a government telegraph system, and he replied with a description of his system, as it stood, in 1836. Responding as he did, at the time he did, was fortunate for Morse, as this letter would later be his strongest claim to patent rights for his system.

During Morse's tenure at the university, he staged several demonstrations of his system as new developments were added. During one such showing in 1837, a young man named Alfred Vail turned up. He was so impressed by the telegraph that he recruited the interest of his father, George Vail, owner of the Speedwell Iron Works in Morristown, New Jersey, a successful manufacturing business of the time.

Morse's partners

As a single parent on a meager university salary, Morse hadn't been able to invest much money or time in his telegraph. The Vails, on the other hand, had money—at least Alfred's father did, and they were willing to invest some in Morse's telegraph. Alfred also wasn't terribly busy at the time and had time to spend on it.

Besides money, Alfred Vail brought a good mechanical aptitude to the telegraph project, having acquired it hanging around his father's iron works. Morse's strengths lay more in the abstract: ideas, research, etc., and thus his equipment lacked both electrical and mechanical sophistication prior to Alfred's showing up.

With Alfred on the job, things began taking on a new look. By early 1838, the two men had perfected the system to the point where it was ready to come out of the laboratory.

They made good partners. One of the first innovations to come out of the Morse-Vail partnership was redesign of the receiver. They changed it such that the paper tape marker now moved vertically, up and down, thereby marking the paper with dots and dashes instead of the previous zigzag pattern. At this point, copying was still done by translating the marks from the tape after the entire message was received. This new receiver did make a click-click sound as it marked the paper tape, though.

Another significant improvement made during this time was replacement of Morse's old cam strip sending system with a "key." Morse's cam strip was akin to a teletype machine's punched paper tape and required that the message be composed prior to sending. The addition of a key allowed direct sending in real time.

From 1838 on, the Morse and Vail Partnership would endure. During this time, Morse also acknowledged his old university colleague, Dr. Leonard Gale, as partner because of Gale's earlier electrical contributions to the system. Morse also recognized Vail's father, George, as a partner, largely because of the money George spent on the project. Later, Morse would find other "partners" he didn't know he had!

A government partnership

While the Vails had deep pockets, estimated costs for building a test line, even over the relatively short distance of 50 to 100 miles, was more than they were willing to spend at the time.

Morse himself didn't have the money, and other investors were reluctant to invest because as yet, no one could see the telegraph as being economically viable. A telegraph, though now possible, was

largely regarded as somewhat of a novelty. Faced with this, Morse decided to turn to the government, and began trying to sell the Congress on funding the first line.

In February, 1838, having seen an impressive laboratory demonstration, a Congressional Committee recommended an appropriation bill to build an experimental line, but the bill failed to pass. For the next two years, the Morse system sat idle while Morse tried to raise money for the project.

During these two years, Morse traveled to Europe seeking foreign support. While there, he approached the English, French, Germans, and Russians in a futile attempt to obtain backing. As one account goes, he was rather badly received in England where Wheatstone was busy promoting his system, and as another story goes, he managed to alienate the Czar of Russia so completely that any mention of the Morse telegraph was banned in Russia. Morse fared no better anywhere else either—foreign diplomacy was not his calling. He didn't raise a dime!

Tail dragging, Morse returned to a rather interesting homecoming. Upon arrival in New York, he found he'd been sacked by the university, which was beset with hard times of its own. Professor Gale, his old friend and partner, was also affected and forced to find a new job out of town. Morse then learned he was being sued by good old Dr. Jackson over whose idea the telegraph really was. Finally, to completely round things out, Morse learned the Patent Office had issued Wheatstone the first US telegraph patent ahead of his own pending application.

Although things looked grim, Morse continued to lobby Congress to fund the project over the following three years. During this time, he was reduced to abject poverty, relying on tutoring art students to make ends meet. Finally, by March 3, 1843, the appropriation bill passed the legislature and was signed by President Tyler. Persistence had paid off at last!

"What hath God wrought?"

Morse had already given up hope for 1843, believing this legislative year had come and gone like those previous. Ann Ellsworth, young daughter of a Washington official, delivered the news of the appropriation bill's passage to Morse a day later. In gratitude, Morse promised her she could name the first message to be sent over the completed line.

The experimental line was to link Washington with Baltimore. Originally, Morse and company planned to bury the line underground due to fears over possible damage by the elements. Unfortunately, that failed after almost nine months of construction, when it was discovered the wire insulation used was inadequate. Switching gears, they started stringing wire on poles overland. On May 24, 1844, with Alfred Vail in Baltimore monitoring, Ann Ellsworth handed Morse her message. It was from the *Book of Numbers*, "What hath God wrought?" Morse personally tapped it out from Washington. Within minutes, Vail signaled back that he had the message and repeated it back over the line as proof the system worked.

The inauguration of the first operational link initially received a lot of attention in 1844, but there wasn't exactly a stampede of people wishing to send telegrams from Washington to Baltimore. It even took some time for the news media to recognize its value. With no immediate financial incentives for building additional telegraph circuits, Morse's system sat relatively unused for some time.

One of the early events to awaken public awareness of the telegraph's value occurred somewhat by chance. The Democratic National Convention happened to be held in Baltimore the summer of 1844, soon after startup of the new line. As one might expect, there was a lot of interest in Washington over what was going on in Baltimore. This interest heightened after James K. Polk received the Presidential nomination, a surprise—followed by a bigger one. Silas Wright was named the Vice-Presidential nominee, and he, upon hearing the news in Washington, announced he would refuse the nomination.

Morse sent a telegram to the convention in Baltimore with this news, but the conventioneers initially refused to accept the telegram's authenticity. After the message was in fact verified (by railroad dispatch), negotiations began, by telegraph, to resolve this nomination dilemma. It ended with the nomination of, and acceptance by, George M. Dallas to replace Wright. While this incident may seem a minor piece of historical trivia, it served to trigger a few key people to recognize the telegraph's potential.

Morse viewed the telegraph as a public utility and continued to operate the Washington-Baltimore line as a free service for a time, but Congress remained uninterested, and the system remained primarily a curiosity. At this point, the Post Office decided to fund the line as part of its operations, but after sustaining two years of losses (they charged 1/4 cent per word), the government got out of the telegraph business.

Earlier in Morse's Congressional lobbying days he'd met Francis O. J. Smith, then the Congressional Chairman of the Commerce Committee. Smith had, at that time, convinced Morse to give him a share of the telegraph system in exchange for Smith's peddling his influence to help raise money. Smith apparently didn't have the influence he thought he had because he was able to raise only dust, not money, during this time.

Smith had since left public life to become a promoter of sorts, probably a better career choice for him. Still claiming his part ownership in Morse's telegraph, however, Smith attempted to form a private company to build a line between New York and Boston. Unable to sell this idea initially, Smith turned to building a line from New York to Philadelphia, and by late 1845 had raised enough money to begin construction.

By early 1846, the line had reached the Hudson River at Newark. While the British had perfected submarine cable technology, Smith and company's cable was not capable and failed under water. This forced temporary use of a river-ferry relay in order to get the line operational by summer.

Near the end of July, 1846, the company began reporting "profits," thus touching off a wave of expansion. It should be noted that the actual profitability was dubious at best, but reporting profits sure made stock sales easy! By 1849, many lines were in and actually *were* making money, partially due to news service and railroad business. In time, Morse gained a fortune through expansions by Western Union and the American Telegraph Company, as did virtually everyone else associated with the telegraph.

By 1860 most of the Eastern US was linked by telegraph lines, and by 1865, the US was linked to Ireland and Europe by the Trans-Atlantic Cable.

Bibliography

Briggs, Charles F. and Maverick, Augustus, *The Story of the Telegraph*, (New York: Rudd & Carleton, 1858).

Finkelstein, Joseph, *Windows on a New World: the Third Industrial Revolution*, (New York: Greenwood Press, 1989).

Jones, Alexander, *A Historical Sketch of the Electric Telegraph*, (New York: G. P. Putnam, 1952).

Prescott, George B., *History, Theory, and Practice of the Electric Telegraph*, (Boston: Ticknor and Fields, 1866).

Reid, James D., *The Telegraph in America, its Founders, Promoters, and Noted Men*, (New York: Derby, 1879).

NEVER SAY DIE

Continued from page 31

But what about all those hemophiliacs who've been dying of AIDS as a result of blood transfusions? It turns out that's tied in with a new drug for hemophilia called Factor VIII. This is an immuno-suppressive drug, so if the patient also is also HIV positive, the chances are that a doctor will prescribe FDA-approved AZT, and that's the end.

Maybe you've noticed that none of the AIDS establishment's frightening predictions have materialized. Our hospitals are not packed solid with people dying of AIDS. The big winners have been the condom manufacturers, Burroughs Wellcome Labs and their AZT sales, the AIDS support groups, and those benefiting from the billions of government money that Congress has thrown into fruitless research (welfare for scientists).

The Duesberg book is a fascinating (if long) detective story, and there is no shortage of bad guys put into the spotlight.

So then how are the Bioelectrifier and the Beck Blood Purifiers pulling so many people back from death? I suspect that by passing a tiny electrical current through the blood it prevents various viruses, microbes, fungi, yeasts and parasites from replicating, thus allowing the immune system to regain enough strength to fight off any number of illnesses which had gotten the upper hand. Like cancers.

And combined with the damage done to people's bodies and immune systems from long-term drug use (including nicotine and alcohol), there is the mutation of microbes which had previously been beaten back with antibiotics. In case you haven't read, most of our more serious invaders are now antibiotic resistant, and the rest are well on their way. This onslaught of infectious diseases also helps defeat the immune system. If you haven't read about it, the current estimates are that over 80,000 people died in 1996 in hospitals just from diseases contracted in those hospitals. That's right, not from the illnesses which brought them there, but from those contracted while there. A hospital is a very dangerous place to be.

I'm not sure whether that 80,000 is in addition to, or part of, the 300,000 deaths the Ralph Nader researchers attributed yearly to hospital errors—mostly errors in medication. I suspect it's in addition.

Dr. Fisher Disagrees

But not a whole lot. In *The Plague Makers*, Dr. Fisher presents a well-researched case targeting not only recreational drug use as knocking the immune system down, thus allowing the AIDS syndrome to happen, but he presents a solid case that the over-use of antibiotics by two specific groups, gay men and drug users, has significantly contributed to the destruction of their immune systems. Both gays and intravenous drug users are constantly having to fight off infections, hence their high use of antibiotics.

If I had any sort of immune systems related illness my first move would be to do everything known to get my immune system perking at peak efficiency. I'd follow the Comby book's raw food diet and change my eating habits immediately. I'd get those UVs into my eyeballs every day, per Dr. Douglass. I'd be out there briskly walking for several miles a day, rain or shine. I'd hyperventilate every hour or so to get more oxygen into my system. I'd make sure I was drinking at least eight glasses of distilled water a day. And I'd use the Bioelectrifier at least an hour or two a day. I would not take any prescription drugs (or other drugs, for that matter). I would make sure I was getting vitamins A, C, and E.

Scientists

A letter from Albert KE4HUD included a newspaper clipping to the effect that the job market is tight for scientists. Now, I'm a real big fan of science and believe that we have a serious need to get our kids interested in high-tech careers. But I don't think I've ever promoted the idea of anyone going on to become a scientist. In general, scientists tend to be a mile deep and an inch wide in their fields, wear lab coats and be super-nerds.

Looking at it from the career point of view, with very few exceptions scientists are never going to make much money. Job-wise they're heading toward one of two possible employment opportunities: working for a large corporation, or a university. Neither of these is ever likely to pay much except in prestige (oh, vanity).

The odds for making money these days lie in being an entrepreneur, and here a high-tech background can be worth zillions. Ask college dropouts Bill Gates or Steve Jobs.

Continued on page 43

The Gel Cell Storage Battery

A great little power supply.

Frank Brumbaugh KB4ZGC
P.O. Box 30, c/o Defendini
Salinas PR 00751-0030

The gel cell storage battery is the king of batteries both for portable operation and for emergency backup power in the ham shack. This type of battery has a great many advantages over other kinds.

Gel cell batteries are tightly sealed, so they can be stored, charged or discharged in any position with no danger of electrolyte leakage or outgassing. No maintenance is ever required.

These batteries are cost-effective, providing a high watt-hour per dollar value. They are widely available from a number of manufacturers and are low in cost, considering their power capability and usual life spans.

In normal use, the dependable service life of gel cell batteries is four to five years when used for standby use, and between 200 and more than 1,000 discharge/recharge cycles as a function of the amount of power delivered before recharging. Gel cell batteries do not have "memories" such as haunt NiCd batteries.

Gel cells possess a very high energy density, resulting in smaller physical size for the amount of power they offer. They are available in many sizes (from vest-pocket to hernia-inducing), and in voltages of 2, 4, 6, 12, and in some cases 24 and 28 volts. They can be connected in series for higher voltages, and/or in parallel for higher load current capacity.

Gel cell batteries can be charged over a temperature range of -20°C to +50°C (4°F to +122°F), and can be used to produce power from -40°C to 60°C (-40°F to +140°F).

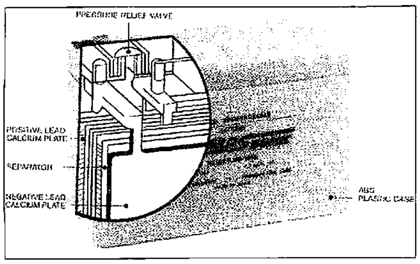


Fig. 1. Internal construction.

Although it's not recommended, gel cell batteries can be discharged much below the normal level (in an emergency), yet retain the capability of fully recovering when recharged. These batteries can also, in pulse type service, supply up to 10 times the ampere-hour capacity of the battery for these very brief pulse periods. Thus, smaller batteries can be used when very high peak current is required for very short time periods without damage.

Gel cell batteries are ideal for portable operation, especially for low power stations, and most QRP operators in this rapidly growing segment of ham radio use these efficient batteries to power their rigs when hiking, backpacking or camping. These batteries are an obvious choice for Field Day, and there are quite a few bicycle mobile stations using gel cell batteries for power.

The larger capacity batteries are most desirable for backup power in the home station, and are usually continually floated across the +13.8 VDC output of the station power supply. This keeps the battery fully charged and ready to supply power to the ham station should commercial power be lost.

Inside that neat plastic box

Fig. 1 illustrates the internal construction of a typical gel cell storage battery. Lead-calcium plates containing a small amount of tin are very strong, durable, and highly resistant to warping or damage due to excessively deep discharging. The electrolyte, a dilute sulfuric acid similar to that used in automobile and marine batteries, is locked into a gel almost like candle wax, keeping it constantly in contact with the plates.

Separators between positive and negative plates are usually made of porous Fiberglas™ cloth which is highly resistant to heat and oxidation. This cloth easily absorbs electrolyte, further stabilizing the battery.

Many gel cell batteries contain a pressure relief valve, as shown in **Fig. 1**. This comes into play *only* with excessive gas pressure caused by overcharging. It is a one-way valve and does not allow ambient air to enter the battery. With normal charging there will never be an occasion for this valve to operate. It is strictly a safety device for a worst-case situation.

The gases produced during charging—oxygen from positive plates and hydrogen from negative plates—combine to form water, which maintains the water content of the electrolyte at the proper level, making a truly "maintenance-free" battery.

The battery case is sealed both mechanically and with epoxy, plastic or hot seal to produce a liquid- and gas-tight container.

Battery capacity-discharging

Gel cell batteries are available with ampere-hour (Ah) capacities of 0.05 to 100 Ah, rated for a 20-hour discharge rate. Capacity in Ah, always expressed by the capital letter "C," is used when calculating or expressing the *rate* of charge or discharge. The Ah capacity of any battery is equivalent to C in all cases. This means that the number of Ah (C) discharged at a rate of 0.05 C, will discharge the battery fully in 20 hours. If the discharge rate is higher, for instance doubled to 0.1 C, the fully discharged state will be reached in just nine hours. Discharge rates are constant in this example, but would be reasonably accurate for average discharge current. These examples apply to all gel cell batteries, regardless of terminal voltage or Ah capacity.

As a concrete example, a battery of 2 Ah (C=2) will supply 130 mA for 20 hours, but if called upon to deliver 260 mA, the battery will be fully discharged in

nine hours. At the high drain of one ampere (C/2), this battery would be discharged in only one hour 20 minutes.

The fully discharged gel cell battery will produce a *per-cell* voltage of 1.75 volts. For a nominal 12 volt battery such as is used by most hams, this is a terminal voltage of 10.5 volts. Conversely, a fully-charged battery will have an open circuit voltage of 2.15 volts *per cell*, or 12.9 volts for a 12 volt battery.

It is best, if at all possible, to refrain from discharging a battery below 1.94 volts per cell. This amounts to 11.64 volts for a 12 volt battery. Because most ham transceivers either quit or operate poorly as the supply voltage sinks towards 11 volts this is not a hardship, and halting discharge current while battery voltage is above the fully discharged state will contribute greatly to overall battery life.

If you're interested in the gory details of discharge curves and more technical information that you'll probably need in this incarnation, ask a manufacturer for their literature.

In choosing a gel cell battery for portable operation, calculate the current your rig draws on receive, and if using CW or SSB, one-half of the peak current drawn on transmit.

Assuming you wish to operate a maximum of 20 hours before recharging your battery, your *average* current drain must not exceed 0.05 C. Preferably it should be less.

Because most operating time is spent tuning and listening on receive and only a small amount of time is spent actually transmitting, unless you're as long-winded as I, a simple way is to calculate the current in Ah used during a one-hour period, with perhaps 50 minutes receive and 10 minutes transmit.

Calculate 5/6 of receive current drain. Then calculate 1/6 of *peak* transmit current drain and divide this by two because the intermittent nature of CW and SSB can be construed as a 50% duty cycle. Then add the two final calculated values together. The sum is your average current drain in amperes for one hour of operation.

A real life example: I have a 12 Ah gel cell (C=12) which powers a QRP-plus transceiver. Receive current is about 0.2 A, and half the 1.5 A peak transmit current is 0.75 A. Taking 5/6 of 0.2 A, which equals 0.167 A (rounded off), and 1/6 of 0.75 A, which equals 0.125 A, and adding these values together gives a total *average* current drain of 0.292 Ah *per hour*.

The 20-hour discharge curve shows that 0.05 C is 0.6 A for this battery. A simple ratio calculation is: .6 : .05 = .292 : x; .6x = .0146; x = .024.

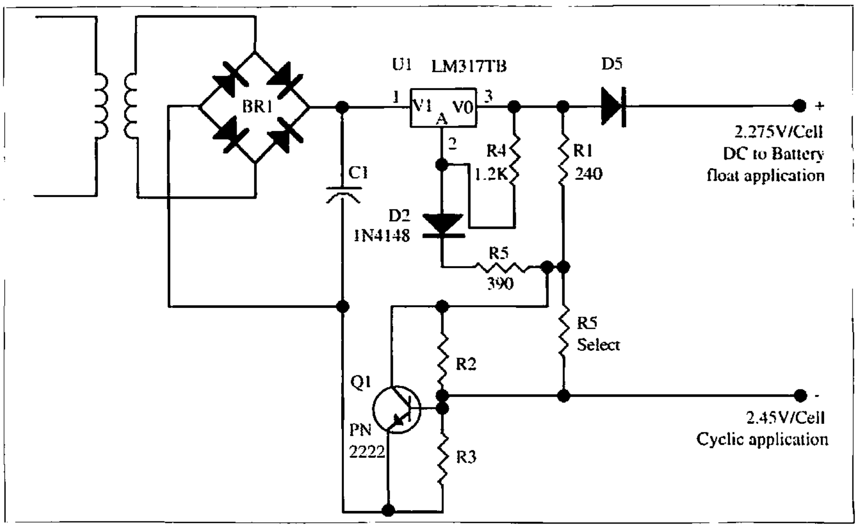


Fig. 2. Constant current/constant voltage charge circuit.

Thus, in this case, the average current drain is equal to 0.024 C, about half of 0.05 C, so the 12 Ah battery will allow about 40 hours of operation before having to be recharged.

Using a calculator, it is much simpler to calculate the ratio with the decimal fractions rather than first converting them to powers of 10 as is customary.

Charging the battery

A new gel cell battery, although fully charged by the manufacturer, needs a bit of exercise to develop its full capacity. This can be accomplished either by floating the battery across the station power supply for a couple months. This is simplest if it is a backup battery for the home station; or has been used for a while, undergoing a number of charge/discharge cycles.

A voltage somewhat higher than 2.15 volts *per cell* (12.9 volts for a 12 volt battery) must be applied across the battery terminals. After discharge, and after charging, the terminal voltage may be temporarily lower or higher, respectively, but in a short while it should stabilize at the 2.15 volt per cell level.

The best charging method recommended for gel cell batteries is the "constant voltage, constant current" arrangement. This will ensure maximum battery life and capacity while not requiring excessive charging time. However, the charging current must be so limited that it cannot exceed 0.25 C, or 1 ampere for a 4 Ah battery, for instance. *This is most important to prevent damage to the battery!*

A large capacity gel cell battery used in float service as backup power for the home station is never discharged very deeply, and recharging requires a *lower* maximum voltage for charging.

Caution: In all cases the charge current must never be allowed to exceed 0.25 C or the battery could be damaged.

The recommended float voltage is 2.25 to 2.3 volts per cell, or 13.5 to 13.8 volts for a 12-volt gel cell battery. This allows the battery to be connected permanently across the output terminals of the standard 13.8 volt station power supply. If the home station is used at least weekly, the standby battery will never need charging unless it has been used in an emergency to power the station.

Constant voltage/constant current charger

Fig. 2 illustrates a simple charging circuit suitable for the small gel cell batteries normally used for portable operation. Because a heat-sinked 317T regulator is used, the maximum current is limited to one ampere. RS is chosen to provide the proper minimum float voltage (0.6/R3 = max).

R2 and R3 are determined by the level of filtered DC voltage available and the maximum current (0.25C or lower) to be applied to the partially or fully discharged battery. They will have to be determined empirically.

The manufacturer of your gel cell battery will usually recommend a charging circuit for your application if you list your expected average and peak current drain and the acceptable discharge terminal voltage when you write. He not only wants your battery to provide efficient service but he also wants to sell you a replacement battery when the time eventually arrives.

NEVER SAY DIE

Continued from page 40

And the way the world is going, the big money is going to be in high-tech businesses for a long time to come.

It is unfortunate that around 95% (or more) of hams memorize the Q&A manuals to get their tickets and the learning process stops soon after. Here's a hobby that offers a world of learning opportunities, with it being fun every inch of the way. But yes, it does take some determination and perseverance to learn about radio, microwaves, digital communications, and so on. And yes, our blessed school system spends K-12 at a minimum doing its best to kill whatever sparks of motivation might have been inherited genetically. Grumble.

Fluorides. Again.

Are you still drinking tap water? What does it take to get you to get a small still and start distilling that sewage your city or town is providing? You don't need any of the toxic metals that come out of your spigots. Worse, you surely don't want to put chlorine into your body, and the chances are that your water system has plenty of that poison.

But the most damaging of all the water additives are fluorides. Oh, there goes Wayne, on some sort of an ecological kick. Oh yeah? If you send me an SASE I'll send you a copy of the results of 30 research lab reports of genetic damage caused by fluorides, plus a list of 35 published peer-reviewed papers attesting to the genetic damage. These research reports show clearly that as little as one part per million of fluorides in drinking water causes measurable genetic defects in sperm chromosomes, and that means some sort of genetic defect will be passed along to your children. And this is not going to be helpful. This can mean small or large birth defects, none beneficial. And these will, in turn, be passed along to your grandchildren. That what you want?

I started out buying gallon bottles of distilled water from the drug store, then Pat Flannagan mentioned an inexpensive still available from Damark. I invested in a Genesis unit, which cost under $200. Works like a charm and has paid for itself many times.

The Dr. Yiamouyiannis book, *Fluoride, the Aging Factor*, which I've reviewed in my editorial, and is on my list of books you're crazy if you don't read, has the subtitle, "How to recognize and avoid the devastating effects of fluoride."

You've read about the decreasing sperm count in American men. Well, fluoride in the water supply has been shown to do this. It's a deadly poison, and helps knock the stuffing out of your immune system.

Do It Yourself!

Put yourself in my chair—well, walk a mile in my moccasins, is the cliché. Suppose you were writing an editorial every month,

Continued on page 55

73 Review

Number 44 on your Feedback card

The Ten-Tec T-Kit 1208 6 Meter Transverter

Here's a fine introduction to modern kit-building.

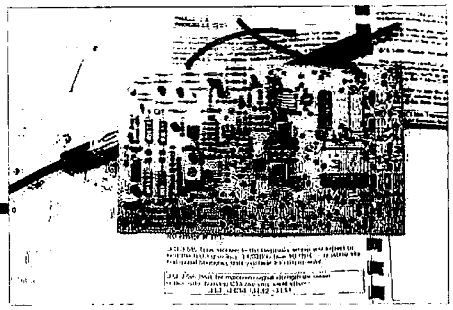


Photo A. The T-Kit 1208. (Photo by NØBLX.)

Peter A. Bergman NØBLX
3517 Estate Dr SW
Brainerd MN 56401

A converter allows your receiver to tune a band for which it was not originally designed. A *transverter* allows your transceiver to receive *and transmit* on a band for which it was not originally designed, by subtracting or adding a local oscillator frequency—in this case, 36 megahertz—from or to the displayed frequency on your transceiver. This gives you access to the added band with all of the wonderful features already present in your expensive HF rig, without spending piles of money.

Suppose your license does not allow you to transmit on the 20 meter band? This is not a problem because you aren't transmitting on 20. Instead, you are using your 20 meter transceiver as a tunable IF stage to control the transverter on 6 meters. If your HF rig will only transceive from 14 to 14.35 megahertz that's still not a problem since a lot of the action is between 50.0 and 50.35 anyway. Receive coverage up to 18 MHz lets you monitor the rest of the 6 meter band.

If you've never built a kit...

Despite some things you may hear about the "Golden Age" of kits, modern kits are great, and when you get a kit from an outfit like Ten-Tec you can durn near write off the cost as tech-school tuition. Add in entertainment value and the satisfaction of a working unit you built yourself and you're way ahead.

Okay, you are thinking about ordering the T-Kit 1208, but what do you need up front? First, a 20 meter transceiver capable of being adjusted to 5 watts output reliably. Second, a regulated, well-filtered 12-15 volt DC power supply capable of about 4 amps. Third, some kind of 6 meter antenna. A dipole will do for starters. And, a 52 ohm dual PL-259 jumper to connect the rig to your new transverter.

Tools? You will need a 15 to 35 watt soldering pencil and thin-diameter rosin core solder. This is a must. Thin-diameter. Rosin core. You will also need diagonal cutters—small ones—and needle-nose pliers, ditto. I like to keep a pair of locking forceps handy. They make great heat sinks while soldering and are useful in many other ways. According to the T-1208 manual, the coils can be wound on a .313" X-acto™ knife handle or a clean 3/8" bolt (that's what I used). The book also said you'll need a wire stripper. That's what I used the X-acto knife for. Alignment tool. Do not try using metal hex wrenches, screwdrivers, etc., as alignment tools. If you don't have any yet go to Radio Shack™ and get their 64-2220B set. I also like to keep a sharpened dental pick on my workbench. It is very useful for clearing holes I soldered shut accidentally, and for unbraiding coax. A 2- or 3-inch paintbrush is also useful for cleaning up.

Test equipment

You've got to have a volt-ohmmeter for this project, and once you get one you'll use it for years. There are some inexpensive digitals available but the better quality you start with the happier you will be with it. I know that a lot of you have tons of test gear but I'm talking to the folks who are just getting started in this great hobby. You will also have to have an accurate RF wattmeter that has a 10 watt scale or slug. If you have a cheapie from your CB days find someone with a Bird to check it for you. Then you can make a correction chart for yours.

Optional test equipment includes a frequency counter and an RF signal generator. I used my MFJ™ antenna analyzer for both jobs. For a second piece of test gear—after the VOM—I'd say that a 249 or 259 from MFJ is hard to beat.

Start your kit

The parts are packed neatly by type in separate bags but let's leave them alone for a while and take a look at the instruction manual.

Kit builders seem to fall into two categories: those who read and follow the directions and those who don't. I try to stick with the former group. More of my projects work that way.

The 1208 manual contains about 80 pages; the print is clear and the text and drawings are concise. A tip of my hat goes to Ten-Tec and Dan Onley K4ZRA who did the writing.

On Assembly page 48 is an important notice about driver transmitter power. Although there are several notices in the manual which tell you that the 1208 was designed to use a 5 watt input, it also explains that changing the value of R5 will allow inputs from .25 watts to 8 or even 10 watts.

It seems to be a fact of life that however well the manual is written there are always some addendum sheets. Go through them carefully and make any needed changes to the manual before starting construction. I

like to run copies of both sides of the addendum sheets and cut and paste them in the appropriate places in the book.

Even if you have built kabillions of devices, and especially if you have not, read the theory section. It will help you understand what you are doing and will explain why the designers made the decisions they did. After that, do the parts inventory.

Each of the seven assembly phases includes a schematic and board layout diagram of that phase, which is very helpful. Phase 1 is preceded by a "dos and don'ts" page so that is a good place to start actual assembly. Somewhere in your collection of baggies is a tiny ferrite bead—about the size of a mustard seed. Following "do 1" install that bead now. That way you won't have to worry about where the little rascal went later after you have been chasing the other parts around for a while.

The first page of construction is board preparation, installing "vias," which ensure that the upper and lower ground planes are tied together. You will also install a few test points and fabricate the test plug. A word of warning to the uninitiated: The test plug requires a 1/4 watt 150 ohm resistor, not the 3/4 watt you will be wanting later.

Another word of warning: I don't care how much money your mother makes or who your dad knows or how big your brother is, please, never, never carry molten solder to the joint on the tip of your soldering pencil. The actual amount of solder you'd have to spill on the board to create hair-pulling problems is infinitesimal. Instead, heat the joint with the tip of the soldering pencil and apply the solder to the other side of the joint. The solder will melt and flow towards the heat and if everything is nice and clean—as it probably is—you will produce a nice, shiny, conductive joint that will stay that way for years.

Yet another warning: Don't use steel wool to wipe off the tip of the soldering pencil. Sure, it does a great job but you will probably have tiny wild hairs of wire all over the place.

If you follow the manual's directions you will not get the 3.3 μH inductor mixed up with the 3.3 ohm resistor. The resistor goes over near where you'll install Q11 later. Handle these small inductors carefully, especially when bending the leads; I managed to torque one in half. T-Kit sent me a replacement as soon as I called, but it's embarrassing and stops production.

Observe polarity—orientation—on all semiconductors and electrolytic capacitors. Every time. I go so far as to install the resistors so the color-code reads the same way. It helps keep me in the habit of paying attention to the orientation and later it might help during troubleshooting. Looks neater too. When installing disk capacitors I try to install them so that I'll be able to read the value code easily after the surrounding components have been installed.

Double-check your work.

We're having fun now

Now comes one of the really fun parts—the Phase 1 progress test. Unlike the "Good Old Days" modern kits like this one are designed to be assembled in functional stages so that each stage can be tested with power on. This way, as you progress through assembly you know you left good stuff behind you. If you skip the progress checks and run into problems later you'll have to go through the entire device to figure out why. Minimum test equipment is an FM broadcast receiver tuned to 108 MHz. Got one, right?

> ***"Using just an indoor dipole antenna, I could hear stations all up and down the East Coast clear into Canada from my home in Minnesota. What a gas!"***

The easiest way I found to perform the Phase 2 progress test was to use a coax adapter on my 4-5 watt 2 meter rig. If you use a transmitter capable of more power make absolutely sure that the output is reduced to 5 watts.

No matter how you feel about progress tests, make sure the TR circuitry works at this point.

There are at least two reminders to make sure that J2 is securely soldered to the top ground plane. Read and heed.

Follow T-Kit's suggestion about putting a spacer between the coil and the board while soldering. You definitely do not want the coil touching the ground plane at any point.

While installing Q15 you may wonder why the designer didn't have you do that before you soldered all those other parts around its space. All the heat you were pouring into the board in that area would not have done the transistor any good. The same is true of the rest of the semiconductors on the board.

When bending the leads on Q15 hold the lead with the tip of your needle-nose pliers next to the transistor body. Work carefully and make sure to bend the leads so they all slide easily through the mounting holes. If you just sort of line them up and pull from the other side of the board you may create enough strain to break the transistor.

As luck would have it, when I got to the Phase 3 alignment test the band was wide open and, using just an indoor dipole antenna, I could hear stations all up and down the East Coast clear into Canada from my home in Minnesota. What a gas!

During these power-on tests and adjustments you will really be glad you took your time and got everything to work as you went along instead of slapping things together and hoping for the best.

I deviated a bit from the order in which the steps are presented in the manual. At one time or another I've worked on everything from typewriters to bulldozers so I have a feel for how I want things to go together. For example, I found it easier to rearrange the steps so that I worked from the bottom to the top when wiring the switches and from left to right when wiring the SO239s.

Make absolutely sure you adjust the lengths of the coaxial cables so that they can be bundled neatly per the instructions. If they are just strung randomly across the board all sorts of unpredictable things can happen. Also, watch what you are doing when cutting the coax. Somehow I ended up with two inches in my hand that needed to be in the kit. Fortunately I had some in the junk box.

Final alignment

You had the receiver working, transmit bias adjusted and reasonable RF output before you installed the board in the case, right? If everything is working to your satisfaction, you are just about finished. You might want to find a spot inside the case to store the test plug, as I did.

The fun of building has actually just started for you because every time you sit down to work you'll know you built it yourself. Have fun on the "magic band" and 73s.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

Every February I get this image, somewhere, of a ham poking his head up and looking around, like the groundhog on February 2nd. But unlike the groundhog, who is looking for his shadow and in that search judging the coming weather, our amateur buddy is looking for software to enable entry into the digital universe.

The questions I receive reflect the great diversity of that quest. Bob Rushby VE3GLA sent along a note saying:

"I've been active on RTTY for some time with a MFJ-1278. Recently, I got the chance to buy an old HAL ST-6000 for a very good price. I'd heard great things about how well it works in weak signal conditions, so I bought it.

"My big problem now is what is the best terminal emulation to use with the ST-6000. The 6000 has 5-bit Baudot i/o, so normal terminal emulations that use ASCII aren't much use. I spent some time surfing the net to find something, but everything I find is for more modern devices like the MFJ, the KAM, etc."

Any suggestions?

Bob, while it may look like you have come up against planned obsolescence, those of us who grew up using World War II equipment 20 or 30 years after the fact know that such does not exist in amateur radio. That HAL demodulator is a fine unit, and should do just fine in service once again. One program to start with is TRTY, which is on the first disk of the RTTY Loop Software Collection. At the end of this column, I'll detail how to obtain these programs.

This program is an MS-DOS-based RTTY program which can also handle packet with a TNC. With a plain terminal unit, the HAL series being prime examples, this program should perform admirably to enable both ASCII and Baudot communication. I would be interested in hearing how well this works out for you on the air.

Of course, if you have a multimode controller, there is always a question about that one. Greg N8TDL writes:

"I have a PK232. What is the best software to buy for Windows 95?"

Along with the XPWare software discussed last month, you might take a look at the newest version of PaketPet. Now in version 3.2, this program from Chuck Harrington runs under Windows 3.1, 95, and NT; along with OS/2, and virtually all hardware TNCs, including the PK-232. Chuck passes along some of the following features:

"Point & Click Interface to Packet Mailboxes. Mail Window passively collects message headers, then left click to read, right to reply! Automatically log mail/traffic sent! Automatically format message line length, insert signature file, spellcheck and send! Integrated 90,000 word Spelling Checker. Three integrated text editors. Signature/Forms files supported. Restartable Yapp and text file transfers supported.

"TNC Settings Editor Dialog Box to display/edit your TNC's settings! ANSI color graphics and sound support. Written in high performance C language. Integrated database listbox to save your packet/Internet addresses."

Fig. 1 shows the display of PaketPet, with many of the features enabled. You can get a copy of the program via the RTTY Loop Download Page, or on Chuck Harrington's page at:

http://www.gate.net/~paketpet/

Either way, having obtained the shareware version, registration to a full package is easy and quick.

When it comes to checking on the RTTY Loop Home Page, pay attention to the details, please! I won't name names, to spare anyone embarrassment, but I received an E-mail saying:

"I'm not having any luck with the web URL that goes like this:

www:2.ari.net/ajr/rtty/

"Got it from a friend of mine and maybe he looked at it without his glasses on! I'm a born again RTTY nut from the old days, I am afraid to say. I like the smell of my 28 machine running. I am interested in any DOS type software for my PC and web pages or reflectors on the subject.

"I guess I need to get off my butt and subscribe to *73* again. Did for over 20 years and then stopped with a job change several years ago. I am just now settled down and getting back in the swing."

Last things first: Yes, by all means, subscribe to *73!* There are no other amateur magazines on the cutting edge, with the freshness, or with this column; not to mention old Never Say Die! As soon as you finish reading this column, rip out that subscription card and mail it in.

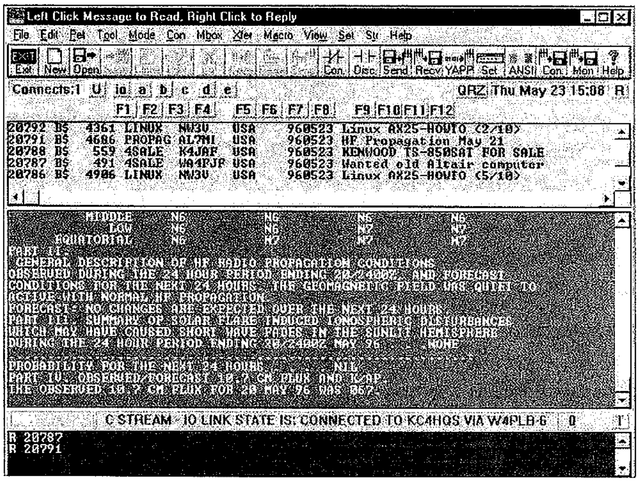


Fig. 1. PaketPet display.

As to the website address, this shows just how critical these things are. There is a colon in there that does not belong. The correct address, with the http: prefix, is:

http://www2.ari.net/ajr/rtty/

Another thing to note in many web addresses is case. With the Unix conventions used on the Internet, upper and lower case are different. In this case, "RTTY" and "rtty" are different, as would be "Software.html" and "software.html." Be careful, and type web addresses exactly as given!

Once you find the page, though, you will find a library of old "RTTY Loop" columns, many links to a variety of amateur radio websites, programs to download, and a listing of all the software available in the RTTY Loop Software Collection. Now, all of the programs in the collection are not online, primarily because I do not have enough space on my web server to put all 20+ Mb of programs up there. I do link to those available online, elsewhere, though, and have put several up in rotation that many have requested. I also can E-mail individual programs as requested by individuals. But, if you want to get the collection, or parts of it, which now numbers over a dozen disks, the simplest way is to either download the index listing, or, if you are not online, send a self-addressed, stamped envelope to the above address and I'll send you a copy of the listing. Then, decide on which disks you want, and send me a 3.5 inch, high density blank disk, US $2, and a stamped, self-addressed disk mailer for each collection desired. So, for five of the disks, you would send five disks, $10, and a mailer or mailers with postage and capacity sufficient to return the materials to you.

As well as providing a source of programs, I look forward to your comments, questions, criticisms and suggestions. Please send them to me via snailmail at the above address, or electronically at ajr@ari.net, MarcWA3AJR on AOL, or 75036,2501 on CompuServe.

Carr's Corner

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Better Ham Software Design? Please?

The only reason I don't refer to myself as a computer geek is that I know the definition of geek (it's a carnival sideshow performer whose act involves biting the heads off small rodents or snakes ... look it up, it's in the dictionary). But I do like computers and computer software. I even teach a class in Visual-Basic 4.0 at our local community college.

What I don't like, however, is computer software that is poorly designed, or which has a poor user interface. And that includes a relatively large percentage of the software written for amateur radio and other radio hobbies.

DOS, by gosh, you're kidding, of course

One pet peeve is MS-DOS software that hasn't been upgraded to Windows yet. Several mini-NEC based antenna design programs, and at least two ionospheric propagation programs, on the market are DOS software. The problem is that DOS software often will not run on Windows machines. As you add software in Windows, it starts taking up space in the lower 640K of memory where DOS resides. If the DOS program is larger than the remaining memory available in the lower 640K, then it won't run (an "out of memory" error is generated).

I've discussed that problem in this column before. The solution is to either use a secondary configuration (as allowed in DOS 6.22) or create your own secondary configuration by messing with substitute config.sys files. But who wants to go to that bother? I want to see an icon on the screen that connects me to my radio program. Double-click it and go. What I don't want to do is mess with multiple configurations of my computer.

Today, the availability of Visual Basic and Visual C makes it too easy to develop Windows programs for there to be any excuse for selling DOS products.

Interface design problems

Even when people design Windows-based software for hams there is often a profound lack of skill demonstrated by the developer. One of the first things I notice is the human computer interface (HCI). I received one product from a small developer that I declined to review in this column because it was so poorly done. Some defects were obvious (like the hideous background color and the fact that he used a pastel that did not permit clear viewing of the eight-point typefont selected), but others take either a practiced eye or one use of the program (then the defects became really apparent).

> ***"I want to see an icon on the screen that connects me to my radio program; I don't want to mess with multiple configurations of my computer."***

That program was written in Visual Basic 3.00 (I could tell because the compressed file VBRUN300.DL_ was present on the distribution diskette—it's the run-time engine for VB 3.0). The program asks the user to input certain data in textbox format, and then it would calculate some neat smoke about antennas for you. Wonderful. It even worked.

But the author of the program did not realize that, unless he intentionally changes the order, the first command button laid down on the screen at design time is the one that receives focus when the program executes. Focus means that the button is outlined in darker grey, and will respond as if the mouse was clicked on it by pressing the <ENTER> key on the keyboard. If a command button receives focus like that, then it should be the command button that initiates the preferred default action. Instead, he focused his EXIT button. So, when a number is entered into the textbox, the natural thing for a user to do is hit <ENTER> rather than <TAB> as he intended. So what happens? The computer terminates the program. Sighhhhhhh.

Two errors were made in that program interface: 1) setting focus to a control you did not want, and 2) not using the <ENTER> key to navigate from one input textbox to the next. The <TAB> key does not automatically spring to mind when using the program like the <ENTER> key does.

Another gripe came from a program that was obviously written in Visual Basic 4.00 (again, the run-time *.DLL file was present). That program used textboxes to display calculated data (which is fine). The problem was that the author did not lock the display-only textboxes. This means that the textboxes could be altered by the user even though the program did not call for it. In VB 3.00 one had to manipulate the Windows API to lock textboxes, but in VB 4.00 it's a simple matter of checking the Locked property as TRUE ... so there's no excuse not to lock the box.

I've also seen problems in programs that cause the thing to bomb out. For example, one program from a source in the UK allows the user to go forward to the next step even if the current step is incorrect. This program calculated the length of antenna elements given certain input parameters. One of the parameters was frequency of operation (F). If a user enters 7150 for the frequency in kilohertz (a legal entry in that program), then the correct answer is produced. But if the user accidentally enters 71t0 by striking the t key rather than 5, then the resulting numerical value becomes zero when the program does its calculations. Guess what that does when F is in the denominator? A divide-by-zero error terminates the program.

The correct way to handle that situation is to provide a means for preventing the user from going forward until the correct entry is made in each inputbox or textbox used for input gathering. Several approaches to this problem are available, so there's no excuse not to do it.

Also, error-handling code should be built into the software in order to trap as many errors as possible. The program might have to terminate gracefully (rather than bomb out), or the error might be user correctable (like entering a valid number for F). Error handling is part of good programming, but seems lacking in much ham software.

User interfaces for programs are what the user sees on the screen. These should be designed according to the UFA principle: Usability, Functionality, and Aesthetic. Usability means that the user can learn to use the program very rapidly. To the maximum extent possible, the operation of the program should be self-explanatory. Functionality means that everything the user needs is available on the screen, or can be reached with simple navigation through screens and menus. It also means that two functional items, or bits of information, that are needed at the same time should be on the same screen. Getting lost in the menu structure should not be possible. The aesthetics of the interface come dead last, but that does not mean that they are unimportant. The screen should be pleasing to view by most people (and that includes using neutral colors), and should be well laid out.

Wherever possible, the standard Windows approach to screen design should be followed. Have you noticed that a lot of Windows application programs look and operate similarly, even though they do completely different things? An advantage of following the usual designs is that the user finds it easier to intuit how the program works. After all, when he or she sees File in the left-hand corner of the Menu Bar, it is obvious what will be found there, and those items should always work the same as in other Windows-based programs.

Color usage

Color pollution is the best label I can think of for many programs I've seen. Color should be used wisely and sparingly on a screen. Color can reasonably be used to divide the screen into different task areas or different types of data. But too many colors on a screen increases the visual search time required to figure out what to do, and where that function is on the screen. Also, research shows that extensive use of color works better for experienced users of a program than for novice users. So design according to the intended level of the user community.

Programmers, by the way, make lousy testers. Even if they are the smartest people around, they are also too close to the project and too knowledgeable about computers in general to make a typical user. If you develop software for hams or SWLs, then have some of them (who are not geeks in either sense of the word) test it for you.

Consistency

Software programs should operate not only consistent with other Windows programs, and other applications of similar type, but they should also be internally consistent. Internal consistency goes two ways.

First, the user should see the same result from the same action every time it is initiated. Further, every time a follow-on repeat of an action is required it should be done in the same manner as in previous attempts (e.g. entering the frequency should not be done in a textbox one time and an inputbox the next).

Second, the system should respond the same way to user inputs every time they are made. In teaching the Visual Basic class I noticed several students who would fail to clear variables and certain input features, and so would create errors because the system thought that something else was intended. Computers are terribly ignorant; they do exactly, precisely what you tell them to do (not what you intended them to do, which may be different).

One good approach to design is to use what the HCI textbooks call forcing functions. These are design features that prevent the program from continuing further until the user input error is corrected. Examples of forcing functions fall into four groups:

Gagging. Prevent incorrect input by using strategies such as keyboard lockout or numeric-only checkers.

Warning. Display a message box or warning label when an error is made. Message boxes should include a suitable set of alternative actions that correct the error.

Do Nothing. This strategy keeps the program from doing anything further until the error is corrected.

Self-Correction. When an error is made the program detects and corrects the error, relying on default values. This may be the most dangerous approach because you may have to correctly guess which defaults are the ones intended.

Mea culpa

I don't want to hold myself out as a supreme expert on software or interface design, or somehow better than others. I've made most of these errors myself—but I've also learned. My software is not perfect, by any means, but at least I've learned these lessons ... and recommend them to others.

Conclusion

Sorry to dump on you folks with my pet peeve this month, but it is an irritant that I suspect afflicts many users of ham radio software (indeed, all software). Good design will make a product look, feel and work better. A lot more can be said about the subject, but I've used up my allotment of space for this time. Perhaps sometime in the future we will return to it. Perhaps. But if the makers of ham radio software get the message, then it won't be necessary. Just remember one thing: The amateur in Amateur Radio only means we do radio for fun, not for money. That does not imply that amateurish products are acceptable in our marketplace. Amen?

Connections...

I can be reached via snail mail at P.O. Box 1099, Falls Church, VA 22041, or via Internet E-mail at carrjj@aol.com.

Number 48 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

The AMSAT Annual Meeting

The 1996 AMSAT Annual Meeting and Space Symposium was held November 8-10 in Tucson, Arizona. Over 250 satellite enthusiasts listened to dozens of presentations and visited the Kitt Peak National Observatory and National Solar Observatory. For all participants it was a fantastic weekend. With the launch of the largest and most complex amateur satellite only months away, the symposium focus was on the status of the Phase 3D project.

Friday

This year the AMSAT Space Symposium began Friday morning with a presentation by Dr. Helen Reed, Director of the ASUSat lab. ASUSat stands for the Arizona State University Satellite. Work is underway to build a 10-pound satellite to be launched as a piggyback payload on a Pegasus rocket. The satellite is designed to carry a GPS (Global Positioning System) receiver, an earth-imaging experiment and a Mode "J" (2 meters up and 70 cm down) analog and digital transponder system. Launch is scheduled for spring 1997.

SEDSAT Project Manager Dennis Wingo KD4ETA brought everyone up to date on the status of the SEDSAT program. SEDSAT-1 is a microsat-class satellite that will be part of NASA's Small Expendable Deployer System (SEDS). Changes in launch schedules have caused delays with this hamsat. SEDSAT will carry several scientific and amateur radio experiments. The SEDSAT program also has a World Wide Web home page at the URL (Universal Resources Locator), http://seds.lpl.arizona.edu.

John Franke WA4WDL described a fascinating hardware project. John's interest in the Russian Tsikada (pronounced Cicada, like the insect) navigation satellites led to efforts to decode their telemetry signals. He built a dedicated "black box" to decode the 150 MHz FM signals from the satellites and display the time data.

Peter Vekinis KC1QF wrote a paper and made a presentation describing changes to his proposed "Picosat System" of low-earth-orbit amateur satellites. Peter proposes a constellation of Picosats all using VHF and UHF frequencies. Like the Motorola Iridium system of "cellular phone" satellites, the Picosats are to use inter-satellite radio links to extend the communications range.

This year's SAREX (Shuttle Amateur Radio EXperiment) talk by Frank Bauer KA3HDO focused on a new program, the Amateur Radio International Space Station (ARISS). Due to the long-term nature of the presence of an in-orbit ham station and the multinational use of the equipment, there are frequency coordination issues and operational aspects to be considered. National groups currently involved include Canada, France, Germany, Great Britain, Italy, Japan, Russia and the United

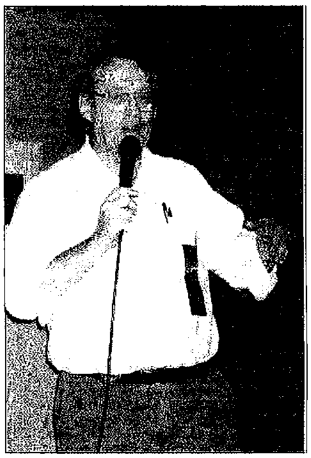


***Photo A.** Dr. Tom Clark W3IWI discussed many topics, including his "Totally Accurate Clock" and the problems with Mexico OSCAR 30.*

States. Goals include organization of all amateur radio manned space flight efforts, support, maintenance and upgrade of current *Mir* and Shuttle amateur radio gear, and the establishment of a single integrated radio system for the International Space Station.

Assi Friedman 4Z7ABA provided the gathering with an update on the Techsat-1 program in Israel. The first Techsat satellite was destroyed due to a launch failure in Russia in 1995. The new version of Techsat is similar to the first with a few upgrades for better digital store-and-forward operation. Two have been built. One will be launched early this year. More information about the family of Techsats can be found on the Internet at the URL http://www.technion.ac.il/~asronen/techsat/.

Other Friday afternoon talks included Gould Smith WA4SXM's description of the activities between the European Space Agency and AMSAT, an explanation of "what it takes" to set up and calibrate a radio telescope for SETI (Search for Extraterrestrial Intelligence), a reception by Dr. Paul Shuch N6TX and a tutorial on spread-spectrum techniques by Phil Karn KA9Q. Phil also presented material on Saturday concerning a high-performance satellite modem.

After dinner the talks continued but with a focus on newcomer topics. Barry Baines WD4ASW got things started with a general tutorial, while Ken Ernandes N2WWD discussed the fundamentals of Keplerian elements. The evening concluded around 10 p.m. with Doug Quagliana KA2UPW and his simple, yet effective, mobile low-power station description. Doug brought along some of his antennas and gear to show the attendees.

Saturday

Activities began in earnest at 8 a.m. AMSAT President Bill Tynan W3XO gave an official welcome to the symposium participants. Dick Daniels W4PUJ got things started with a Phase 3D construction update. The satellite is in the final stages of integration in the Orlando (Florida) lab. Launch is scheduled for April on the second Ariane 5 rocket from the Kourou, French Guiana, facility. All of the major components are in place and ready to go, with only a few exceptions. Work will continue at an accelerated pace to get everything ready and tested by the end of February.

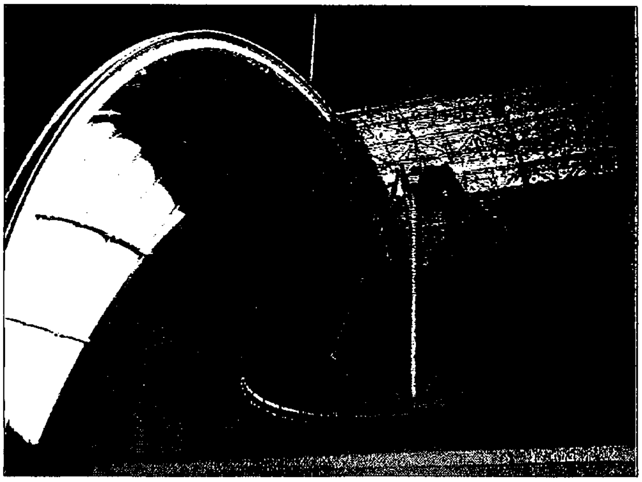


Photo B. *Most symposium attendees went on the Kitt Peak tour. This 12 meter dish at the National Radio Astronomy Observatory has been used above 300 GHz.*

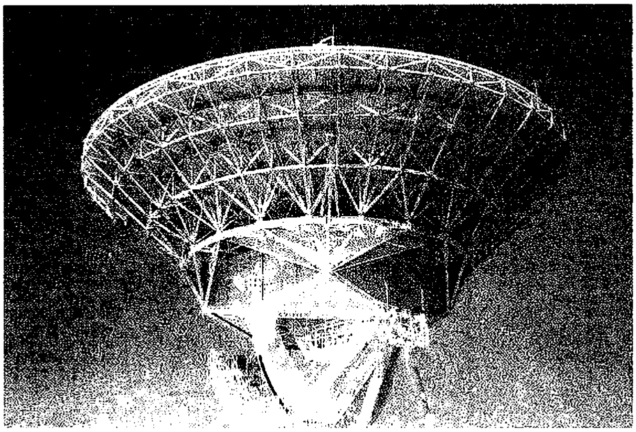


Photo C. The 75 meter dish at Kitt Peak is part of the Very Long Baseline Array (VLBA) network of radio telescopes. Those on the tour got a close-in look at all of the systems. The dish is used at frequencies up to 47 GHz.

Bdale Garbee N3EUA has been working on the Phase 3D GPS (Global Positioning System) receiver system. The original design has been scrapped and two new GPS receivers are being provided by NASA at the Goddard Space Flight Center. The purpose of the GPS receivers is to determine the viability of using GPS for orbit and attitude determination at orbits above the GPS constellation.

An update on the digital systems of Phase 3D was provided by Chuck Green NØADI. The system is called RUDAK. This is a German acronym for *Renerativer Umsetzer fur Digitale Amateurfunk Kommunikation.* This roughly translates to Regenerative Transponder for Digital Amateur Radio Communication. The program has a long history from its beginnings over a decade ago in Munich, Germany. The latest version will start its operational life as an orbiting packet-based digital communications system. Later in the mission it will be reprogrammed for new and faster digital modes. Development for this new version of RUDAK has been based in Tucson, Arizona, and includes many members of TAPR (Tucson Amateur Packet Radio Corporation).

A Saturday talk by Dr. Tom Clark W3IWI (**Photo A**) discussed extremely accurate time signals available via the GPS (Global Positioning System) satellites. Tom's device, called the Totally Accurate Clock, provides an interface between a small GPS receiver and a computer. The resulting timing signals are accurate to intervals of less than a microsecond.

An afternoon presentation by Ed Krome KA9LNV covered a Phase 3D-related topic. Ed presented "The View From Below: Thoughts on Phase 3D Ground Station Requirements." Due to the many ham bands covered by Phase 3D, the nature of the final orbit and the power output of the satellite's transmitters, working Phase 3D from the ground will be quite different from current satellites. Ed proposed the use of small microwave dishes with multiple concentric or offset feeds and small VHF/UHF yagis all mounted on a single boom. The use of mast-mounted downconverters and transmitconverters was proposed for modifying current ground-based systems to operate new modes of Phase 3D.

Saturday was not all Phase 3D. Past AMSAT board member Harry Yoneda JA1ANG provided an update on the operation of Fuji-OSCAR-29. AMSAT President Bill Tynan W3XO presented some thoughts on possible projects beyond Phase 3D. AMSAT Vice President of International Affairs Ray Soifer W2RS gave his observations on the "Amateur Satellite Service in 1996," while Richard Limebear G3RWL expressed his concern for the future of amateur satellites.

Prior to the banquet, Bill Tynan hosted the annual AMSAT meeting with members of the Board of Directors and AMSAT officers on stage. This is always a great opportunity for AMSAT members to ask questions of a group that is only together in one place once a year.

Following the meeting and some time out for "attitude adjustment," the yearly banquet, awards presentation and prize drawing were held. The banquet speaker was Darrel Emerson AA7FV. Darrel is in charge of the 12 meter radio telescope on Kitt Peak near Tucson. His discussion of radio astronomy and the pioneers that opened up this fascinating field was quite thought-provoking. It was also a preparation for the incredible tour scheduled for Sunday.

At the awards presentation many AMSAT supporters were honored and a special plaque was presented to the American Radio Relay League for their work to provide over $500,000 for the Phase 3D program. After the awards, prizes finished the evening. They ranged from books, T-shirts and maps to gear from SSB Electronics, an antenna system from Larsen, a mobile transceiver from Kenwood and an all-mode VHF/UHF transceiver from ICOM.

Sunday

Following the Field Operations Breakfast at 7:30 a.m., everyone took off for Kitt Peak in chartered buses. For satellite enthusiasts it's hard to imagine anything more exciting than the close-up tour of the Phase 3D facility that occurred at the 1995 AMSAT Space Symposium. Kitt Peak may not have any satellites to look at, but the technology, electronics and giant dishes of the National Radio Astronomy Observatory were incredibly impressive. The AMSAT Board of Directors meeting was postponed so that everyone could attend.

The tour included the 12 meter radio telescope (good up to 300 GHz) and the 75 meter radio telescope (good up to 47 GHz). The 75 meter dish is part of a global network of identical dishes that are used together to create the VLBA (Very Long Baseline Array). Tom Clark W3IWI provided details about the coordination of observations between locations.

A walk through of the 12 meter dish control room and a "hard-hat" climb through the feedline room at the back of the 75 meter dish provided real perspective to the show. The clear air, high altitude and incredible view in all directions are hard to describe when experienced from the support structure of a giant radio telescope.

The tour didn't end with the radio telescopes. The Symposium attendees also got a chance to view the Mayall 4 meter optical telescope, the 2.1 meter telescope and the incredible National Solar Observatory. The solar "telescope" is 500 feet long, mostly underground, and looks like a giant temple built by an ancient or alien civilization. It is used to study the complex surface motions of the sun in order to gain a better understanding of the interior.

After the all-day tour, Bill Tynan W3XO started the AMSAT Board of Directors' meeting, which lasted through mid-Monday with a few breaks for food and sleep. The agenda covered many items, including publications, SAREX, ARISS, long-range planning, new satellites and the budget. The Phase 3D program was again the main topic. AMSAT still has a significant challenge ahead to pay its part of Phase 3D and maintain other activities. Launch date slippages cost money, just to keep testing and other contract work going until launch.

Toronto, Canada, is the site for the 1997 meeting. It is sure to be a fascinating event since Phase-3D will be in orbit by then. Watch for more information on the AMSAT Web page at http://www.amsat.org.

Copies of the "Proceedings" of the symposium are available from AMSAT or the ARRL. The softcover book is 8 1/2" by 11", 232 pages. It's well worth the cover price of $12. AMSAT can be contacted at 1-301-589-6062 for details on shipping charges. 73

HAM TO HAM

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

Just a reminder to keep the "Ham To Ham" column in mind whenever you run into an interesting solution to a problem in your pursuit of amateur radio. I need lots more input to keep the column lively and interesting. Any idea, suggestion, tip or solution is fair game, as long as it has applications to the hobbies of electronics and ham radio. We've all discovered unique approaches and resolutions to our common problems, and "Ham To Ham" is the ready forum for sharing them with other *73* readers. Just jot down your ideas and send them to the address above; I'll let you know if I can use them and roughly when they'll appear. Include an informal sketch if you feel that would help explain your suggestion, and a short text (handwritten or typed), and I'll take it from there. I'll put it into the tone of wording that I've been using for the column and redraw the illustration if needed, so don't let formality hold you back. Now to this month's ideas.

"By merely typing 'dir,' on an infected disk, you can spread the virus to your hard drive!"

Viral protection

From Terry Huckleberry N5FYI: Protecting your computer from an insidious viral attack: "Most virus infections occur as a result of people exchanging diskettes. The best mainline protection against infection is therefore the pre-screening of *any and all* incoming disks. Even before reading the disk's directory!

"Most viruses also lie dormant for a period of time, before self-activating and causing any critical damage to your system. During its dormant stage, however, the virus can be reproducing, spreading itself into other areas of your system, undetected. The sinister virus programmers aren't looking for instant destruction, but rather for the widespread latent destruction made possible by waiting patiently to attack. This is one of the features that can make the more sophisticated viruses so devastating. Early discovery and elimination ends the virus's life-cycle.

"The solution? Virus-scan *everything* that you import into your computer before doing anything with that program. Scan all outside floppies before even reading their directories. A friend of mine recently downloaded a virus scanner and found that there was a virus in the zip file of the virus scanner itself! Scan each installation of every program or data file; in most cases, you can stop the viral spread beyond the initial file that contains the disease if you're consistent with this policy.

"Any virus detected should be considered dangerous!

"A further warning: Even factory-sealed program disks can't be considered absolutely virus-free, and due to the way in which files are often packaged, a program loaded directly from a factory-boxed disk can't usually be fully virus-scanned until it's installed on your system. The best policy then is to re-scan for viruses after each installation (and before actually running the program) on any newly installed outside programs. This may seem extreme to some, but so is the damage that can occur from an infected outside disk."

Moderator's note: Terry brings up some important points. It's a shame that we even have to worry about things like this, but we've all heard the horror stories of intentional viruses. As programming techniques and packaging alternatives become more sophisticated, it may be less likely that viruses will be able to spread as readily as they do today, but until that time, it's best to stick with the safest approach. There are numerous virus scanning programs available today, and Terry mentioned that he's had good results with F-Prot© and Thunderbyte© virus scanners, to name just two. Additionally, make sure that your anti-virus program is a recently updated version; as the anti-virus scanners become more adept at ferreting out the culprits, the virus programmers often counter with sneakier viruses, reminiscent of the old nuclear "Cold War" days!

From Rich Measures AG6K: Some tips for dispelling the equalizing resistor myth, and straightening out some of the confusion surrounding the use of equalizing resistors and capacitors across high voltage diodes: "In days of yore, when silicon diodes were first introduced to the consumer electronics market, the absolute 'need' for equalizing resistors and equalizing capacitors across the newly discovered critters was admitted by virtually everyone. Today, things are a lot different. Silicon rectifier manufacturing technology has come a long way, and inherent similarity from device to device is the norm, not the exception. So are equalizing resistors and equalizing capacitors across the current offering of silicon rectifiers really needed now?

"No. In fact, they can actually cause problems of their own in the series high-voltage power supply circuits found in most amateur HF linear amplifiers. Here's why: The little 1/2 watt carbon composition resistors normally used in this service were never designed to handle more than about 350 volts maximum DC across their relatively small carbon elements; most high voltage diode stacks used in modern linears are expected to carry twice that voltage, or more, safely. So, over time, internal stresses within these 350 volt resistors can eventually cause one or more to break down—usually by decreasing gradually in value—and then the domino effect takes over. In short, one or more resistors fail, putting that much more strain on the rest, and eventually causing catastrophic failure of otherwise perfectly good parts in a series circuit such as the one described.

"Instead of using equalizing resistors and capacitors these days, just make sure that the total PIV of the entire silicon rectifier stack will handle the total peak voltage to be expected, with substantial safety margin to spare, and leave it at that.

"One factor that should be recognized, however, is that all of the rectifiers in a series-connected circuit should have similar junction capacitances—using the same type number rectifiers will normally assure this. If they're not equal, then the reverse-voltage across the lower capacitance rectifiers will tend to be excessive, because smaller capacitors charge faster than bigger capacitors. It's a good idea, therefore, if rectifier types must be mixed in a series circuit, to equalize with disc capacitors. If some 6 amp rectifiers are used as replacements in a circuit using 1 amp devices—assuming that's all that the repairperson has on hand—then a .01 µF disc cap across each device may help, but only because of the wide variation between those 1 amp and 6 amp rectifier natural junction capacitances. Again, there's no need to add 'equalizing' caps and resistors in a series circuit having all the same part numbers—and it can even do harm.

"Here's one thing of interest that I once ran into, though it's not by any means a common problem. I encountered a production run of silicon rectifiers that apparently had poor spot-welds inside the rectifier casing itself. Internal heating and cooling eventually caused these welds to break, completely opening the rectifier from current flow—not a healthy condition in a series HV circuit. If one of the capacitors in the circuit is not being charged by its respective rectifier, then reverse current can be forced though it, and the results are noisy and messy. If you ever run into just one open silicon rectifier in a series HV circuit, don't take chances. For the 10 cent price of a rectifier today, replace all of them, just in case it was the product of a poor manufacturing run. The normal failure mode for these devices is a dead short, caused by too much forward or reverse current, not an open. Be forewarned. Be suspicious."

Power supply tips

From Peter Albright AA2AD: Some tips and techniques on practical linear power supply troubleshooting. "Linear (not 'switching') power supplies are sometimes the easiest of the many circuits to be found in ham transceivers to troubleshoot, and they're also often the most prone to failure due to the demands imposed upon them. Quite often, diagnosis of other circuit failures can be traced to incorrectly operating power supply circuitry, so this part of the chain should always be checked for proper operating parameters before going into the more complex circuitry.

"Most power supplies can be thought of as containing five basic blocks: 1) the input interface block (the input line cord, protection circuit, power transformer, etc.); 2) the rectifier block (where AC is converted into pulsating DC); 3) the filter block (where the pulsating DC is converted into smooth DC); 4) the regulator block (where output voltage stability is determined); and 5.) the output interface block (where current limiting resistors and/or wires and PC board traces carry the supply voltage to other stages of the transceiver). By thinking of the power supply in terms of individual blocks, it's often easier to isolate problems in the power supply using the logical steps of elimination.

"The first analysis of any suspected power supply problem can begin with the unit's cover in place. Is the line cord in good condition, is the fuse intact (if accessible from the outside), what (if anything) unusual was noticed at the moment of failure, was anything spilled on the unit or did a voltage surge or lightning strike occur? Was there any smoke or perhaps unusual noise associated with the failure? All of these 'external' clues can help lead us to the eventual solution to the problem. Always look first for the obvious, it can save countless hours of needless troubleshooting time (an intermittent AC line cord or fuse holder, for instance).

"Once the cover is actually removed, leave the equipment unplugged and begin your visual inspection. Do any parts appear to be overheated? The transformer should be carefully inspected for signs of excessive heat (and odor associated with hot varnish), resistors should not appear darkened or discolored, electrolytic capacitors should not be leaking or bulging and all wiring or printed-circuit board traces should be free of signs of excessive heat or thermal stress. Do the solder connections look clean and bright and are component leads clipped off so that they won't short to adjacent solder pads? Checking the power supply circuitry visually can save a great deal of time and effort if done systematically and with care. Anything at all that 'appears' suspect, should be removed and checked (or substituted) before going on.

"Now we're ready for the power-on test, but be very careful—most power supply circuits can have lethal voltages present when operating, at least in the area of the primary fuse and the AC line circuitry. Always know where these points are before putting your hand inside of the chassis and proceeding with any voltage tests.

"Having a schematic diagram can be a big help at this point. Check the diagram and locate the output regulator or regulators, then measure their input and output voltages with respect to ground. If you don't find the expected voltages (which are generally indicated on the diagram), then the problem could be in either direction, i.e. either the correct voltage isn't being applied to the regulator's input, or the regulator is bad or the output voltage is being dragged down by a higher-than-usual current demand somewhere in the circuitry that's being fed by that regulator. If you can open a link to that subsequent circuitry (by removing one end of a resistor, a steering diode or simply removing a wire), then you can eliminate the circuitry being supplied power as the source of the problem.

"If you don't have a schematic diagram or other technical information, all isn't lost; often you can assume that the normal voltage reading obtained with a voltmeter across each of the large electrolytic filter capacitors will be about 80% of the voltage marked on the capacitors. It's not exact, but often enough to determine proper operation at least. Many times, voltage regulator ICs will have their regulated output voltage coded into the part number, such as a 7805 is a 5 volt regulator and a 7812 is a 12 volt device. Again, by working back through the various blocks, you can often tell if a reading 'seems' normal or if it's 'out of the ballpark' altogether. Experience helps, but experience is only gained through actual troubleshooting practice. Chances are, you'll do better than you think you're able to do, just by using these logical steps and thinking of the circuits in terms of the five basic blocks mentioned earlier. Why not give it a try?"

Moderator's note: Pete does a good job of outlining some time-honored procedures for power supply troubleshooting. Knowing the normal failure modes of components is also helpful when attacking power supply problems; here are a few:

Fuses always open (badly blackened fuses usually mean a high-current short). Power diodes normally short (smaller signal diodes, LEDs and small zeners usually open). Resistors normally open or change value with overheating. Transformers can open or overlapping turns can short internally (some transformers have internal thermal protectors that can open). Dry capacitors (such as disk capacitors) normally short or become very low-value resistors. Electrolytic capacitors can leak, dry out and lose their capacity to store energy. They can also short, often with dramatic results. Voltage regulator ICs can open, short or change their output parameters (they can also oscillate at times).

Note that these are the normally "expected" failure modes of components in power supply service, others are also possible. I've seen power transformers go up in smoke, high voltage electrolytics explode, regulator ICs blow apart into tiny pieces, resistors sputter and smolder, plastic insulation on wires completely melt away and fuses weld themselves inside of their holders. Power supplies or their feedlines are generally where these sorts of things happen, so any suspect power supply component should be considered for replacement as a precaution.

Cable IDs

From Dave Hyman KBØONF: "Time to start saving those little square plastic closures often found on plastic bread bags; they make nice cable identification tags. A drop of lacquer thinner will remove any printed matter on the tags, and a sharp black permanent marker will allow you to write your own information in its place. They fit nicely on most sizes of cabling found around the average ham shack, but the hole can also be enlarged a bit with a hobby knife if needed. If the tag refuses to stay on a particular cable, try putting a small piece of good quality transparent tape across its split edge."

Moderator's note: Nice idea, Dave Does anyone have any other favorite cable-marker schemes? Here's something to complement any cable marking idea: Instead of trying to put all of the information needed on the tag itself, use a "cable schedule." It's simply a form (make up one and photocopy a bunch of them) that shows a cable's number (such as #100), the type of cable (RG-8X coax), the source (FT-1000MP Antenna Jack), its destination (Linear Amp Input Jack) and its purpose (RF feed from transceiver to linear). A sheet of standard (8-1/2 x 11") paper will easily hold the information needed on 20 or so cables when oriented in the 11" (landscape) direction. A cable schedule allows you to put just a cable number on each end of a cable, rather than trying to describe what the cable's function is on a rather small tag...that's all done on the schedule form sheet instead. The cable schedule form gives more information than would ever be possible otherwise, and permits you to change the function of a cable when redesigning your station—only the entry in the cable schedule form need be changed. We used cable schedules extensively in broadcast installations, considering the cables more or less permanent, and only their functions as changing. Do it in pencil. It's logical and flexible once you've become used to it, but you do have to keep it up to date if it's to be of value.

Cleaning up after a hamfest

From Mark Marholin KE6JJR: "You can often make those not-so-attractive 'hamfest specials' come back to appearing close to new, by simply mixing some hydrogen peroxide and water as a cleaning agent. Hydrogen peroxide is inexpensive, and can be obtained at any drug store, but it does a nice job of cleaning grit, grime and tobacco smoke stains from a piece of equipment. It also kills bacteria and breaks up organic matter—that might have been an unexpected bonus—with its bubbling or cavitation action. The exact proportions can be arrived at experimentally, but a 50-50 blend is a good place to start, since the typical consumer-available hydrogen peroxide is usually only about 3% strength. Give it a try and see how it works for you. By the way, it's also used as a bleaching agent, so avoid getting any on your clothing."

"Mark's tip is another reason why hydrogen peroxide may deserve a reserved spot on your bench."

Moderator's note: I've kept a bottle of hydrogen peroxide on my workbench for years for applying to small cuts and scrapes on my hands, because of its anti-bacterial properties; an MD friend told me about it long ago. Mark's tip is another reason why hydrogen peroxide may deserve a reserved spot on your bench. I've also found Dow™ foaming bathroom cleaner (available at supermarkets) good for cleaning particularly grimy equipment panels and cases. It too has a cavitation action that breaks away stubborn collected material, but test it first on an out-of-the-way spot to make sure that it's compatible with the paint and silk-screening used on your rig—you don't want to "clean away" important information!

Murphy's Corollary: Explaining something so clearly, and in such detail, that no one could possibly misunderstand it, will inevitably guarantee that someone will.

That wraps up this month's column; does anyone have any ideas on "different" uses for common items such as K9PKM gave us? Send them, or any other ham-related tips, ideas, suggestions or shortcuts to me at the address in the masthead, and I'll share them with the rest of *73's* readers. That's our purpose, sharing practical ideas Ham To Ham.

Many thanks to this month's contributors, including:

Terry Huckleberry N5FYI
2409 Osage Road
Gatesville TX 76528-1846

Richard L. Measures AG6K
6455 La Cumbre Road
Somis CA 93066

Peter Albright AA2AD
28 E. Summit Street
Lakewood NY 14750

David L. Hyman KBØONF
1455 Edgcumbe Road
St. Paul MN 55116

Mark Marholin KE6JJR
1588 Four Oak Circle
San Jose CA 95131

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73*, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73* for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to *73*'s Ham To Ham column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

QRX . . .

Continued from page 8

Interesting Web Sites

If you have Internet access, and are interested in looking up various callsign information, you may find the following web sites useful:

http://www.webbuild.com/~ki4hn/vanity.htm

This site contains the latest information on the issue of "vanity" callsigns. There are files which include listing of all vanity callsigns issued on each day, since about the July time frame. There are also files which contain a collection of all the callsigns issued by call area. The files are updated daily. If you are interested in following the vanity callsign program, this is a good place to look for information.

http://www.ualr.edu/~hamradio/callsign.html

This is a page at the University of Arkansas. It has an up-to-date copy of the FCC database. The information at this site is usually only a day older than the information at Gettysburg.

Essentially, this site can serve as an equivalent of the *US Callbook*. Additionally, it has some search capabilities. For example, if you want to look for all the hams with the name of "Higginbotham," the search engine will show there are 48 in the FCC database. Or, if you want to look at all the hams in North Attleboro, the search engine will show there are 74. It shows the number of hams in Attleboro to be 87, including one with a British callsign and two with Japanese callsigns.

Take a peek at either of these web sites if you happen to be "surfing the net":

www.lantz.com/cbs

This URL is a pointer to a site that tracks recent changes. It has a pointer to a US file, and it has pointers to files for each state. It doesn't, however, seem to record recent vanity callsign changes.

www.arrl.org/fcc/fccld.html

This URL is a pointer to a database of the recent FCC database changes. It is said to cover about a six-week period. You can scan this using any call that might have changed in the six-week period. You can query using either the "old" call or the "new" call. This seems to be about the best place to look for "very recent changes."

By Dick WS1H, in *"The Chirp 'n' Click,"* December 1996, the official newsletter of the Sturdy Memorial Hospital ARC.

Number 54 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Crunch, Crunch!

If you've spent much time around radio gear, you know it can have its share of problems, just like all electronic things. Some of the issues are similar or identical to what you find in camcorders, stereos and the like. Some, though, are peculiar to RF, and are common enough that we have names for them. One of the most often heard complaints is that a radio has the "crunchies." What the heck is that?

A "crunchy" radio is one that transmits a characteristic sound of teeth crunching. OK, it's really just a crackling noise, but it does sound like the transmitting operator is munching on popcorn while carrying on a QSO. Of course, perhaps he or she is doing exactly that! Such an obvious explanation aside, it's safe to assume the radio itself is the source of the crunching noise, and some remedy must be applied. So: What causes crunching noises in a transmitter?

Pick one

Unfortunately, there's no single cause. While it might seem intuitive that crunching sounds are generated by bad connections (and many are), the kinds and locations of those connections can be surprisingly difficult to pin down. Also, some crunchies are caused by effects not related to bad connections at all! So, let's take a look at the crunchies and how you can get rid of them.

Is it me?

Before you go trying to solve your rig's crunching problems, be sure it really is your radio that's doing the crunching! Repeaters, themselves, are quite prone to the crunchies, and many operators think their radios are the problem when the real trouble is up on a hill, miles away. Often, the listener reporting the sound is no help; it's amazing how many people forget they're operating through repeaters and attribute everything they hear to the other op's rig.

Easy crunch

Some cases of the crunchies are easily solved. If your microphone cable has a broken wire inside, it can still work because the two ends are touching each other. As you move it around, though, it'll cause massive crunchies. I've heard plenty of mobile rigs doing that, and have had a few myself. Usually, the cable damage occurs right near the plug, although sometimes it's at the mike itself. Often, you can just cut the plug off and reattach it after snipping off an inch or so of cable. Before you do, though, wiggle the cable while transmitting and listening on another rig, to be sure you've found the bad spot.

Another common cause of crunchies is the PTT switch. Older rigs used relays (themselves a serious crunchiness offender) to switch between transmit and receive. The relay didn't care about the exact resistance of the PTT switch, as long as it was low enough to provide sufficient current for pulling in the relay. With today's solid-state switching, it's another story. In most of today's rigs, the PTT line is an input to the microprocessor. Like the relay, the micro doesn't really care whether the switch has some resistance. However, that line often also does some other things, and, when the switch's resistance goes up, it can make the radio go haywire. I've seen flaky PTT switches cause everything from bad crunchies to making the radio try to transmit and receive at the same time! It pays to carefully squeeze the PTT while listening to another rig.

The other end

An often-overlooked, but common, cause of crunchies is bad antenna connections. I remember one case in which the mobile rig's SO-239 connector had accumulated greenish gunk inside, presumably because the radio was on the floor of the car and had seen plenty of rain, snow and moisture. The result was poor contact with the antenna plug, and a bad case of the ol' crunchies. That kind of antenna problem can wreck the final amp module, too, because the SWR goes up and down quickly and constantly. Luckily, no damage was done.

Naturally, bad connections to the power supply can cause crunchies. Although the problem can be at a terminal or even a fuse, it doesn't seem to happen much in mobiles and bases. HT battery tracks, on the other hand, do it all the time. Often, a good cleaning with a pencil eraser will do wonders—and that brings us to the ultimate crunch machine:

"Always check those BNCs; it makes sense to expect trouble there."

The ubiquitous HT

Although lots of different kinds of rigs can crunch, the ones I hear most often, and the ones I've most commonly had to fix, are handhelds. Heck, I've seen brand-new HTs that were crunchy right out of the box. Why are HTs so prone to this problem? There are several reasons. First, the RF output is usually via rubber duck antenna, which puts a great deal of RF right back into the walkie. That can lead to crunchies for reasons I'll shortly explain. Second, HTs are very small constructs, with sensitive stages quite close to each other, shielded only by small amounts of thin metal. Finally, handhelds take a lot of physical abuse, due to their being carried around all the time.

Shield me

When there's lots of RF pounding on the shields of sensitive circuits, as there often is in a rubber-duck HT, those shields had better be nice and tight! Even a cold solder joint can exhibit enough rectifying ability to cause RF feedback. Heck, even the unsoldered edges of small shield cans are capable of spreading the RF around unevenly enough that there's some potential between various parts of the shield. That makes the shield into a radiator, and it radiates RF right into the circuits it's supposed to shield. Now, if the exact properties of that shield vary as you squeeze or move the rig, what do you get? Yup, the crunchies!

The average modern walkie is constructed in two halves, usually with a ribbon connector between them. That's in sharp contrast to the old style of construction, which had one big board in the middle of the frame, and perhaps a small microprocessor board behind the keypad. The old way was better in one respect: It rarely led to the crunchies, because the grounds were all tied to the same frame. The newer, split style means that, right off, there are two grounds, one on each side. Remember, at VHF and UHF, it only takes a fraction of an inch for a ground plane to become an inductor, and that spells trouble with a capital "C." Most HTs have a metal tongue that extends from one side to the other and is intended to connect the two grounds. Does it work? Well, kind of. When the rig is new and clean, it works pretty well, but as the handheld ages and a little grime gets in there, and the tongue's spring tension relaxes, the integrity of that all-important connection gets questionable. You squeeze the rig, causing the tongue to rub slightly against its contact on the opposite side of the radio, and it makes that characteristic sound. The rig goes "crunch."

Mostly on TX

Why does this problem affect transmitting so much more than receiving? On receive, there's no

big source of RF against which the shields have to protect. Sure, the various internal oscillators make some noise, but not at the level of watts of power! Shielding and grounding problems that aren't even *noticeable* on receive can be troublesome on transmit. I remember one stubborn case of the crunchies in a brand-new HT that turned out to be a cold solder joint on one of the four corners of the shield over the VFO circuit. The rig worked fine on receive but was intolerably crunchy on transmit. As it turns out, VFO and PLL circuitry is particularly sensitive to shielding problems. Heck, this radio had three of the shield's four corners soldered just fine, and it still didn't work right! If you have a crunchy rig and the obvious solutions aren't working, check those shields on the circuit board. You can usually spot the ones over sensitive circuitry because there'll be a hole for adjusting a coil or trim cap.

I had another crunchy handheld I was sure had this problem. I soldered *everything* I could find, and it still crunched. I even soldered parts of the frame together, because they were held only by tiny rivets, and I thought perhaps that was the problem. No dice. No matter where I pressed, the rig crunched. It finally turned out to be a dirty BNC antenna connector! I cleaned the hole on top with a tiny rolled-up piece of paper soaked in contact cleaner, and the problem went away. From now on, I'll always check those BNCs. After all, the contact area is pretty small, and it's exposed to lots of environmental stuff like dirt, smoke and moisture, so it makes sense to expect trouble there.

By the way, HF rigs can be crunchy, too, often for the same reasons as VHF/UHF radios. Some cases of HF crunching, though, are caused by simple RF feedback into the microphone amplifier circuit, so always check for that by transmitting into a dummy load before assuming the radio has a real problem.

Well, I think we've crunched enough for one month. Next time, we'll look into something else. Until then, 73 de KB1UM.

NEVER SAY DIE

Continued from page 43

and not one like 99.99% of the magazines you read, but like mine. What would you write about? Try sitting down at your word processor and let's see what you can come up with.

Have you had an exciting adventure in amateur radio? Have you read a book that you think everyone really should know about? If you haven't had any exciting amateur radio adventures, why the hell not? What's wrong with you? The doors to adventure are right there in front of you at every turn. Are you blind? And if you haven't read a truly fantastic book recently, why not?

Have you done anything, learned anything, built anything, which might be of interest to the *73* readers? If so, start writing. If not, get a life. It doesn't have to cost a lot to get on packet or our ham satellites. Heck, a DXpedition to St. Pierre or Anguilla doesn't cost much, and will give you things to write (and even talk) about for years.

Or maybe you're a CW fanatic and can tell us how you went about learning to copy the code at 50 wpm? Or faster? If you wanted to, I'll bet you could learn to copy 50 wpm in two or three weeks and have the time of your life. But then you might want to get Congress to pass a law making everyone else learn to copy 50 wpm. Or become an ARRL Director. Or both.

You're an editor. You have a deadline coming up in a couple of days. What are you going to write about? Now get busy. If you can get me excited enough, I'll publish it. Oh yes, don't forget to send both hard copy and a disk. And please don't forget to use your spell checker.

I'll tell you what. If I find I'm getting more good stuff than I can fit into *73*, I'll reprint your editorials and send copies to the editors of the several dozen ham club newsletters I'm getting. Many of 'em are in pathetic need of interesting material.

Once you get the hang of writing you'll be surprised at how easily the ideas come. I've never had a time when I sat down to my typewriter or word processor and was stumped for something to write about. No dry spells. Worse, I've gotten way ahead. A few months ago I published a

Continued on page 69

Number 56 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton CA 92633

Build a multiple polarization quad

Cubical quads are the most popular antennas for VHF and UHF radio direction finding (RDF) in many places around the country, including Southern California. One reason why you see so many quads on vehicles at our hidden transmitter hunts (T-hunts) is that quads can easily match the polarization of the hidden signal. This can make the difference between success and failure in some cases.

Let's say that the signal you're tracking has horizontal polarization, but you are using a vertically-polarized RDF system[1]. This cross-polarized condition means that the direct incoming signal is between 14 and 25 dB weaker in your receiver, reducing your effective RDF range. Worse yet, any signals from the hider that propagate to you by reflection from nearby buildings, intermediate hills, and distant mountains undergo a polarization shift. That makes them appear stronger, relative to the direct signal, than they would if your antenna had horizontal polarization. As a result, you might end up chasing reflected signals throughout the entire transmitter hunt, never getting accurate bearings on the direct signal.

With a simple slip joint at the boom-to-mast junction, a 2 meter quad is easily changed from horizontal to vertical polarization or to any other linear polarization angle. By adjusting your quad's polarization to maximize signal strength at the start of each T-hunt, you can avoid the problems of hunting cross-polarized signals.

The slip joint method has a few drawbacks. Sometimes it's not easy to tell for sure what polarization the hider is using, so you must check again occasionally as you progress toward the T. That's not fun if you have to stop and get out in the rain. Sometimes there are several transmitters to be found with different apparent polarizations, requiring frequent changes. Wouldn't it be better to be able to make the selection quickly from inside your vehicle?

Crossed yagis have been successfully used by T-hunters for polarization agility. Back in April 1989, "Homing In" described the setup of Vince Stagnaro WA6DLQ, who put the elements of two KLM yagis on one boom with separate feedlines and a switchbox to select six polarization modes. Many T-hunters, including your columnist, prefer quads to yagis because they are more compact. A typical mobile-mounted quad provides a better RDF pattern than a yagi of the same size. Hence, I have considered designing and building a multiple-polarization RDF quad for a long time. A recent inquiry by KD6IFZ on the Internet T-hunting mailing list motivated me to move the project onto the front burner.

> **"By adjusting your quad's polarization to maximize signal strength at the start of each T-hunt, you can avoid the problems of hunting cross-polarized signals."**

One quad, two feedlines

While separate driven elements for horizontal and vertical polarization on one quad could probably be made to work, a more elegant solution would take advantage of the cubical quad's inherent symmetry, which makes all elements able to support both polarization modes simultaneously.

Let's go back to basics for a moment. AC currents at VHF frequencies in antennas behave differently from AC currents at 60 Hz in your house wiring. The quantity of electrons passing per second along the power cord of your toaster is the same at the plug end, the toaster end, and everywhere in between. But if you could measure the RF current at several points along the driven element (DE) of a quad antenna, you would find that it differs. This property makes the DE radiate transmitted signals and pick up received signals.

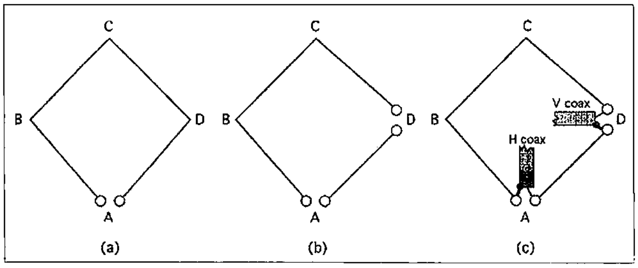


Fig. 1. At (a), the driven element of a horizontally-polarized quad. The feedline connects to point A. Breaking the loop at point D as in (b) does not affect horizontally-polarized operation. Attaching feedlines at A and D as in (c) allows extraction of both horizontally- and vertically-polarized signals, if the outsides of the coaxes are decoupled.

Fig. 1(a) shows a typical quad driven element loop. Circumference is one wavelength, about 80 inches at 2 meters. The feedline is connected to point A, which gives a horizontally-polarized transmitted signal. Received signals of horizontal polarization induce currents in the loop that go down the feedline to the receiver. Vertically-polarized signals induce currents within the loop also, but magnitude and phases are such that they cancel out at point A.

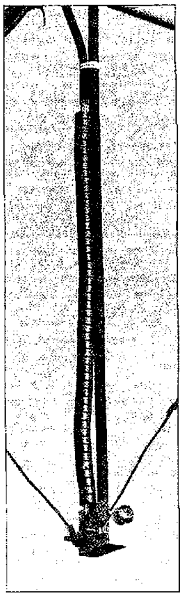


***Photo A.** One of the 50-bead baluns without the heat-shrink tubing.*

RF current from the transmitter is highest at point A. There is another transmitting current maximum at point C. At points B and D, current is at a minimum. Theoretically in a perfect quad, loop current would be zero at these points. In a practical beam, it is less than 1 percent of the maximum.

If there is indeed no current at point D, why can't we just break the loop there, as in **Fig. 1(b)**? You can! If you have antenna analysis software such as ELNEC[2], try this as an "exercise for the reader." Insert a very high value resistive load at point D in the DE of your favorite diamond quad model for any band. If the quad is symmetrical, then the resonan frequency, pattern and feed point impedance will show very little change.

With the added break, we have the driven element of **Fig. 1(b)**. Feeding it at point A gives horizontal polarization, while feeding it at D gives vertical polarization. Both modes can be handled by the quad simultaneously. So why not just hook a feedline to each point and switch from one to another at the receiver, as in **Fig. 1(c)**?

Whoa! Breaking the loop and adding a 50-ohm load at a current minimum will not affect it, but adding an unbalanced feedline certainly will. The braid of the coax becomes part of the antenna. As another ELNEC exercise, hang a long wire (representing the

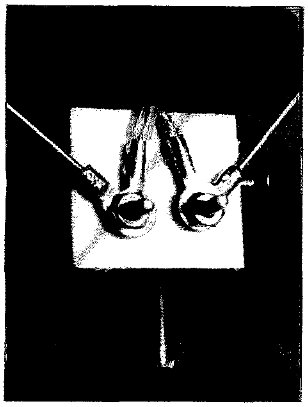


Photo B. Close-up of a feed point block. The first bead fits over the point where coax shield and center conductor are separated.

coax shield) at a current null point in your favorite quad DE and watch the pattern change for the worse.

Fortunately, current flow on the outside of the coax can be choked off to restore the current minimum. A balanced-to-unbalanced transformer (balun) will do it. RF current will be confined to the coax inner conductor and the inside of the shield, and will remain near zero for cross-polarized signals. For the unused polarization mode, it is almost as if the coax isn't there at all!

VK5RN has documented a circularly-polarized quad for OSCAR satellite work that has two feedlines with sleeve baluns[3]. These devices, sometimes called bazookas, are made from thin-wall metal tubing of carefully selected diameters. I did not want to use a pair of bazookas on my T-hunt mobile quad because they are heavy and would add lots of asymmetrical windload at freeway speeds. Instead, I tried a choke of ferrite beads. Measurements by W2DU[4] show that 25 beads of #43 ferrite material over a coax line provide 850 ohms impedance to currents on the outside of the shield at 2 meters.

Does it work?

I built a modified Cubex Yellowjacket[5] four-element 2 meter quad by installing two feedline termination blocks instead of one. Part number FB-43-2401 beads[6] have an inner diameter of 3/16", so they fit nicely over the RG-58/U feedlines once the outer jacket is removed. The two feedlines go down the 3/4" Schedule 40 PVC pipe mast to a two-position coax switch in the van, then to the receiver. Coaxes are exactly the same lengths to make it easier to achieve circular polarization, as will be shown later.

At a local hilltop, I compared the new dual-polarization quad to an unmodified Cubex Yellowjacket using a calibrated attenuator plus local and distant repeater signals. The results delighted me. The directional pattern of the dual-quad was just as good as that of the reference quad. Cross-polarized signals were attenuated 14 dB by the dual-quad, which represents about 3/4 scale on my receiver's S-meter.

Forward gain of the dual-quad was about a half dB less than the reference, a negligible difference. Making the comparison was difficult because when testing the stock quad, the S-meter would vary plus or minus 20% as the feedline was moved around inside the van, due to feedline signal pickup. On the other hand, output of the dual-quad was rock solid with feedline movement, thanks to decoupling by the ferrite baluns.

About this time, a Saturday night mobile T-hunt was getting underway. I decided to give the quad a real workout. KD6LOR and KK6ME had put out three hidden T's, transmitting intermittently on 146.565 MHz. Only one was copyable when I left the hilltop. By switching between feedlines, it was easy to tell that this signal had horizontal polarization. After I had gone a few miles, I began to detect weak signals after each transmission from the strong T. I toggled the coax switch a few times and determined that the weak signals were stronger in the vertical mode.

I found the strong signal first. It was in KD6LOR's truck in a parking lot overlooking Mission Viejo. Sure enough, its transmitting antenna was a horizontally-polarized quad. I then took on the other two T's, which clearly had vertical polarization. There was now a bit of overlap in the transmissions and it was nice to be able to switch polarization to minimize the signal from the horizontal T while hunting the others.

Before long, I had found both of the weaker T's. Each had a quarter-wavelength vertical whip antenna mounted on a surplus ammunition can. One was chained to the base of a high voltage power line transmission tower, while the other was in a park on a steep hillside overlooking Lake Forest. This hunt was enough to convince me that a polarization-agile quad would be my new "weapon of choice" for many future hunts.

Although gain and pattern of the test quad proved to be excellent, SWR was over 2.5:1. Upon further testing, I found that the DE was resonant at about 141.5 MHz. Apparently the pigtails between the ends of the bead baluns and the feedline blocks add to the DE's resonant length. I shortened the DE wires, which improved SWR but caused the pattern's back lobe to worsen. After some experimentation, I found that moving the reflector four inches closer to the DE made the SWR even better and minimized the back lobe.

SWR is now 1.6:1 for both polarizations. This is fine for receiving, because the feedline is decoupled well. Your receiver probably does not have exactly 50 ohms input impedance anyway. I also tried 50 beads per balun instead of 25 (**Photo A**). This increased cross-polarized signal rejection from 14 to 17 dB.

You can make one

Your favorite 2 meter corner-fed no-gamma diamond quad design should be suitable for use with this dual-polarization feed technique. Baluns of 25 beads each are adequate for RDF and inexpensive.[7] You will need to strip the jacket from RG-58/U coax for the beads to fit. Do not strip or comb the shield braid under the beads. If your coax diameter is so small that the beads will go over the jacket, it is not standard RG-58/U and not recommended for VHF.

Cover each balun with heat-shrink tubing and add a dollop of hot glue or other sealant at the ends before shrinking to keep water out. Keep the shield and center conductor leads from balun to feed block short. Remember that they add to the DE resonant length. These pigtails are just 3/4" each on my quad (**Photo B**), compared to 1-1/2" in the Cubex instructions.

As a check of your dual-feed quad's construction, try

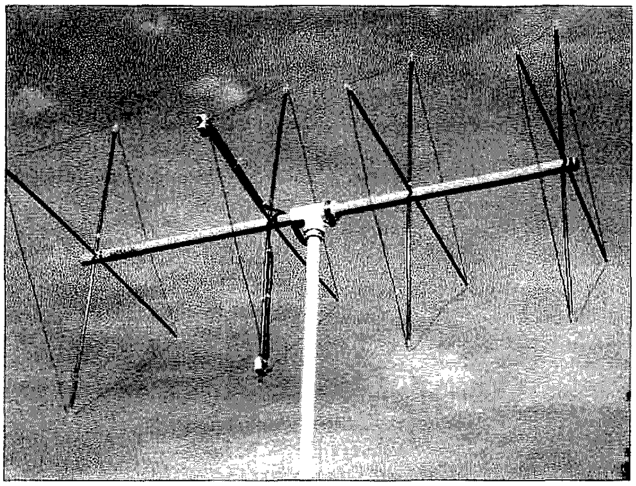


Photo C. The dual-quad is mounted and ready for a hunt. Note that the feedline passes over the top of the boom, but does not wrap around as it does in stock Yellowjacket quads.

transmitting on 2 meters into one feedline while terminating the other with a wattmeter and a good VHF dummy load. Very little RF should leak from coax to coax. In my case, transmitting 22 watts into the horizontal coax gave only 6 milliwatts out of the vertical coax, and vice versa (35 dB isolation).

Wire lengths of the DE on my modified Yellowjacket are 18-3/4" for the wire between the two feed blocks (measured screw-to-screw), and 59-3/8" for the wire that forms the other three sides of the loop. Lengths of the other Cubex element wires are unchanged. Cubex instructions call for six turns of feedline around the Yellowjacket boom, but these added turns are unnecessary and undesirable when the ferrite baluns are in place (**Photo C**). Cubex suggests using RG8X low-loss feedline, but the difference in loss for short mobile T-hunting feedlines is negligible.

Hiders occasionally transmit unusual polarizations. For instance, an ammunition-can T propped up in a tree may put out a signal polarized at a 45-degree angle between horizontal and vertical. There have even been some circularly polarized T's to find on our Saturday night hunts.

By combining signals from the horizontal and vertical feedlines of the dual-quad with proper phase relationship, you can achieve 45-degree and circular polarizations. "Homing In" for April 1989 has plans for WA6DLQ's six-position polarization switchbox. Though intended for use with his dual-feed yagi, it will also work with the dual-quad. A similar switchbox is in the Radio Society of Great Britain's *VHF/UHF Manual.* Feedlines from switchbox to each feed point must be exactly equal lengths when using the switchbox.

If T-hunting in your area requires you to make frequent polarization decisions, consider adding a dual-polarization quad to your bag of tricks. Ed Buchanan of Cubex has agreed to sell a dual-feed version of the Yellowjacket quad to "Homing In" readers. It includes two feed point termination blocks and associated hardware. Contact Cubex directly and ask for the T-hunt Special. Please understand that I have no business association with Cubex, so do not send inquiries about this offer to me.

Whether you make your own dual-polarization RDF quad or try the modified Cubex Yellowjacket, let me know how it works for you. Send E-mail to Homingin@aol.com, or write to me at the address at the beginning of this article. Don't forget to check out the Homing In Web site: http://members.aol.com/homingin/ is the URL.

References:

1. Dopplers and time-difference-of-arrival RDF sets use vertically polarized dipoles or ground plane antennas.

2. Available from Roy Lewallen W7EL, P.O. Box 6658, Beaverton, OR 97007.

3. Robertson,"The Quadraquad—Circular Polarization the Easy Way," *QST*, April 1984, page 16.

4. Maxwell, "Some Aspects of the Balun Problem," *QST*, March 1983, page 38. Ferrite baluns are also briefly described in recent editions of *The ARRL Handbook*.

5. Cubex Quad Company, 2761 Saturn Street, Unit C, Brea, CA 92821; (714) 577-9009.

6. Available from Amidon Associates, P.O. Box 956, Torrance, CA 90508; (310) 763-5770.

7. Prices for FB-43-2401 beads from Amidon are $4.50 per dozen or $16 per hundred, plus shipping/handling.

Number 58 on your Feedback card

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119
clhough@aol.com

Microwave Stripline Retuning Procedures

This month I would have liked to cover the synthesizer that I used for the 1296 MHz transverter presented last month. However, I haven't completed the conversion documentation in sufficient detail. I *have* made the unit function as described. Still, notes and other details must be reconfirmed for accuracy—I will get the details to you as soon as possible.

Instead, this month I will continue trying to provide ideas on how to convert surplus microwave material for use on the amateur bands. This has been partially covered, but here are the full-blown details covering tuning procedures, and specifically the methods that Kerry N6IZW and I use in converting microstripline circuitry. These procedures were developed by Kerry and are presented in a general format, suitable for all microwave/UHF amateur bands of interest. Here are Kerry N6IZW's modification details for retuning surplus microwave microstrip circuits for the amateur bands:

In recent years, considerable quantities of surplus microwave equipment have become available to the amateur community. The reasons for adapting surplus equipment rather than building from scratch often include cost, time and performance. The cost for a typical piece of microwave surplus purchased by an astute amateur will be far less than the cost of a few new components. Often many hours that would otherwise spent in locating components, fabricating boards, and building enclosures are saved.

The performance obtainable is usually quite good due to the commercial processes used to fabricate the units in quantity. Most surplus microwave equipment is tuned for commercial or military frequencies, making it unusable on amateur frequencies without modification. This is what causes the same piece of equipment to be so much junk for one person, but a treasure for someone equipped for retuning.

High technology: good news and bad news

Microwave circuit fabrication techniques have progressed from waveguide to microstrip printed circuit boards to ceramic substrate hybrids to large-scale monolithic integrated circuits. Waveguide-type equipment still finds favor among those beginning on the amateur bands at 5.7 GHz and above, but microstrip circuits are prevalent among those building medium- to high-performance amateur equipment through 24 GHz. The good news is that the microstrip surplus is typically available because the industry is moving into higher and higher integration technologies such as the hybrid or MMIC.

The bad news is that the newer technology equipment often contains integrated components which are internally matched or tuned for a specific frequency and are not practical for most amateurs to modify. An example of a nonmodifiable piece of surplus is the typical VSAT terminal now becoming available. These units contain >1 watt transmitters at 14 GHz and low-noise receivers around 12 GHz, but are so highly integrated that very few of the microwave components are usable for amateur purposes.

The conversion of microwave surplus equipment may eventually dwindle as the modifiable technologies disappear, but this should not be a problem for some years to come. Another good side of the newer technologies is that they provide high performance with low cost and ease of application for those assembling their own microwave circuit boards

using new components. Below are some examples of successfully modified surplus equipment.

C-band TVRO LNAs

These low-noise amplifiers are available in the $5 range at local flea markets. In their original condition, they provide about 50 dB gain with a 1 dB noise figure over the 3.7 to 4.2 GHz range. They require about +15 to +24 to operate with power being supplied to the output connector. When the internal filters are removed the amplifier is usable over the .8 to 4.2 GHz range, with the noise figure increasing to about 3 dB at the low end. I have used one of these units as the 2.4 GHz LNA for an OSCAR-13 receiver.

Ku-band power amplifiers

Several types of 14-14.5 GHz power amplifiers with 25 dB or more gain and .5 to 2 watts output are available for about $35. These units are readily retunable for use on the 10 GHz amateur band, with somewhat increased output over that available at 14 GHz.

Ku-band LNA

Several types of Ku-band TVRO and VSAT LNAs are available in the $20 range. These can typically be retuned for use on the 10 GHz amateur band, providing 20 dB gain and a 1 to 3 dB noise figure.

Tools and test equipment: signal sources

Almost any available source that can be set to the frequency range of interest can be used. Usable sources include commercial signal generators as well as Gunn, transistor, FET, and YIG oscillators. The frequency stability of most sources is more than adequate for tuning microstrip circuits. Short-term amplitude stability is needed; often a single matching element adjustment may change the output by less than 1 dB. The signal level needs to be large enough at the beginning to have measurable output appear, but should be reduced to keep any stages from possibly saturating. For small signal devices the input should not exceed about +5 dBm to prevent device damage.

"An astute amateur can buy a piece of microwave surplus for much less than the cost of a few new key components."

Attenuators

Attenuators (3 dB minimum) should be applied directly to the input and output of the circuit to be tuned, for two reasons: To reduce any possible test setup mismatch that might otherwise be compensated for in the tuning process, and to protect the power measuring equipment and the equipment being tuned. This is a particularly important point when working with power amplifiers which may accidentally oscillate during the tuning procedure.

Power monitors

Almost any type of power monitor can be used as long as it has sufficient resolution and stability to identify changes of .5 dB or less. I started with a spectrum analyzer but found a power meter to be much more satisfactory for detailing small changes.

Power supplies

Power supplies should be well regulated and have current limiting which is adjustable to just above the nominal operating current. The bipolar devices typically use a single power supply while the GaAs devices typically require a negative gate bias. The gate bias should normally be applied prior to applying the drain voltage to prevent possible device damage caused by the transistor attempting to turn on hard.

My experience has been that the properly adjusted current-limited supply will prevent device damage should the gate bias be accidentally removed during the tuning process. Always remove power when making connections and soldering tuning stubs. Make sure the amplifier output is terminated before applying power. The power supply ground output should be connected to earth ground.

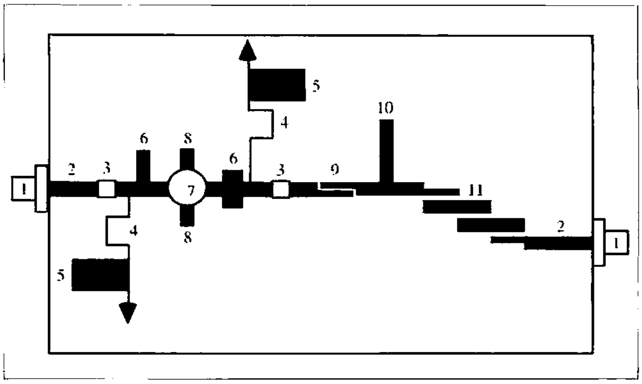


Fig. 1. Typical microstrip circuit components, showing layout of microwave amplifier filters and associated stripline components:
1. RF input/output connectors
2. Main 50Ω microstrip transmission line
3. DC blocking/interstage coupling capacitors
4. High impedance bias lines >100Ω, usually 1/4 wavelength (as long as these are narrow lines, no modification needed
5. 1/4 wave pads to provide RF ground to bias lines (open one end), normally no modification needed
6. Matching stubs may be symmetrical or asymmetrical (may need to be removed for best results)
7. Bipolar or FET device: FET gate values typically -.5 to -1.5V; FET drain values typically +2 to +9V
8. Emitter or source ground pads (direct connection to ground plane is critical)
9. Interstage filter/DC block; typically, cut with craft knife and insert capacitor (difficult to retune)
10. 1/4 wave bandpass filter (one end grounded), typically disconnected at main transmission line; possibly retunable if length/ground point can be modified
11. Bandpass filter, modifiable with some success by symmetrically extending all elements of filter.

Soldering on

A soldering iron with a very small grounded tip is essential. The grounded tip is absolutely necessary to prevent 60 Hz power line or static potential from damaging GaAsFET devices. Small signal GaAsFETs are often damaged if the gate voltage exceeds 3 to 5 volts. The drain voltage limit is typically 5 to 8 volts. The limit for power devices is usually a few volts higher.

Microstrip tuning techniques

Here is the basic approach I have used to retune many surplus amplifiers:

Everything must be grounded to power (earth) ground including the soldering iron tip. The typical FETs in microwave amplifiers will self-destruct with more than 5-10 volts on the gate.

Apply only as much input RF power as required to get usable output measurement. This reduces the chance of damage to higher power devices prior to getting the output matched. Also, it prevents saturation of a stage which then appears not to respond to tuning. Applying more than about +10 dBm directly to small FETs may cause damage.

Use current-limited power supplies set to limit slightly above the normal expected operating current. This will in most cases prevent blowing up the FETs if the negative gate bias is missing or something is accidentally shorted with the tuning wand. With this approach, sequenced turn on of

the power supplies is not usually important.

Place attenuators directly at the input and output of the amplifier. This removes the effect of poor cable, source and power detector matching. Always remove power when making connections and soldering tuning stubs. Make sure the amplifier output is terminated before applying power.

"Several types of 14-14.5 GHz power amplifiers are readily retunable for use on the 10 GHz amateur band."

Tuning procedure

Prepare the tuning wand and tuning stub material. Cut about 1" or 2" strips .080" wide (not critical) of about the same width as the main 50 ohm microstrip lines in the amplifier from thin copper or brass stock (.003" to .010"). Tin both sides of the strips and flick off excess solder. Make several tuning wands by cutting one end of a wooden toothpick square at the largest diameter. Using SuperGlue™, attach a square (.080" x .080") of the prepared tinned copper or brass to the curved end of the toothpick. Wipe off excess glue from the exposed side of the square and let dry.

Remove existing tuning stubs. Using an X-Acto™ knife, make a deep enough cut to disconnect tuning stubs from the main 50 ohm line. Be careful not to cut the thin brass lines. If you are unsure of possible damage to the bias lines, carefully check continuity or use a magnifier to do visual inspection before applying power. In some cases it pays to go through the agony of removing the stub completely as the correct new stub placement may overlap and cause problems.

Connect the amplifier to the signal source, attenuators, power detector and power supplies. Turn on the power and adjust input attenuation for as low an input as can be readily detected on the output. Start at the output and slide the tuning wand along (in contact with) the main 50 ohm line, watching for an increase in output. Note the maximum output reading obtained with the wand. Remove power and solder a square of the prepared material in the same position as noted by the wand.

Do not add solder. The tinning is normally sufficient to allow the new tuning stub to be held in place with the pointed end of a toothpick and then just touched with the soldering iron to reflow the solder. Turn on the power and verify that the output is as high or higher than obtained with the wand. Move the tuning stub if required to obtain results equal to or better than those of the wand.

Slide the wand over the previously attached new stub and if improvement can be made, attach another square. Continue this for the entire length of the main 50 ohm line until no further improvement is found. Increase the input power if working with a power amplifier and retune the output stage for maximum power. Be careful here not to mismatch the output so badly with the wand as to damage the FET.

The process can be very slow, with some stubs only gaining a fraction of a dB. In most cases it will take all of those small increases to get good results so don't expect to see major improvement with a few stubs. It may take four stubs per stage sometimes to get the maximum output.

Additional notes

Direct grounding of a microwave power device emitter/source is essential for proper operation. Any form of insulating grease can prevent full gain/power output from being obtained.

When mounting boards into enclosures, take care to ensure that the entire perimeter of the board is connected to the enclosure to prevent oscillation. 73

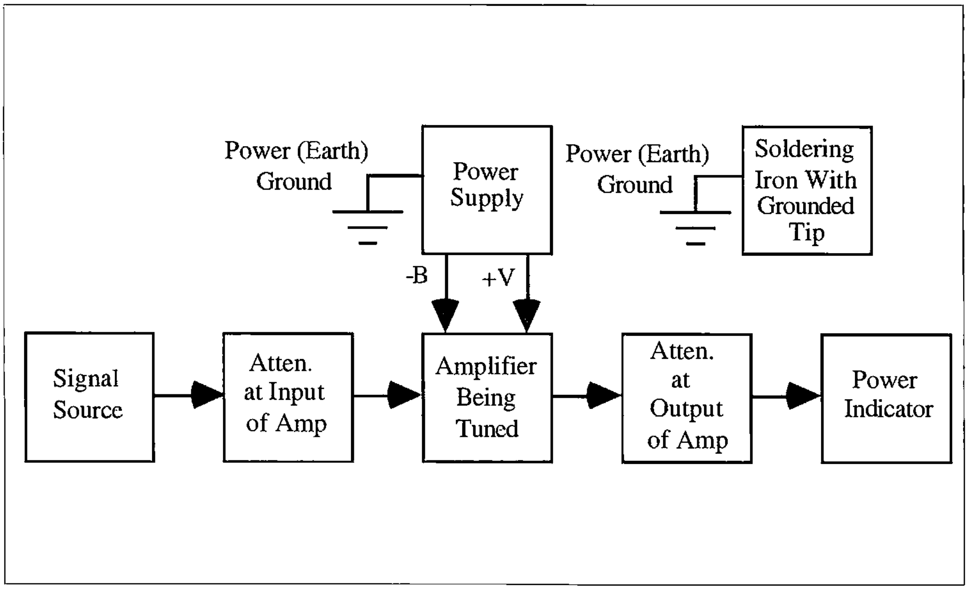


Fig. 2. Equipment configuration for retuning microstrip amplifiers.

LETTERS

Continued from page 7

truly are the unsung heroes of amateur radio—I thank you all, and please do keep up the great work! There are people out there who really do appreciate it.

Aw, shucks... Wayne.

Roger Wendell WBØJNR. Wayne, in "Never Say Die" you asked if we'd like to hear you talk about something besides ham radio. You bet! How about the beauty of 3.5 billion years of organic evolution and what hams can do to save it? We don't need any more money schemes, dirty religions, or mindless hobbies—we need more of nature—the real world.

Roger, I've flown over the Pacific Northwest, so I've seen the ugliness of clearcutting our forests. I've seen the horrendous scars of strip mining. I'm also seeing the pollution of the radio frequencies, with around 30,000 rock music radio stations crowding my AM and FM dial, and 200 or so TV channels of mind-rotting crud. Our school system is crumbling. Our health care system is just as bad as our school system. Crime, drugs, welfare, and so on. Yes, we've made a real mess of our states, country and planet and we're trying to figure out how to go out and spread it to other planets. So what do we do, knuckle under and try to cut as big a piece of the pie as we can for ourselves, and to hell with the mess we make doing it? Or do we fight? But how can you fight City Hall? I've already proposed a way we can secretly infiltrate the "system" and start changing it, working from the inside. Roger, we hams are 700,000 strong, but only if we're working together. As individuals we're of no significance. Yes, as small a group as we are—we have the potential to change our cities, our states, our country, and then the world. Our foes are entrenched interests, apathy, and indifference. Our strength is a never-say-die attitude. Motivation. Determination. Perseverance. Roger, 700,000 people can be an army... Wayne.

Cliff Gieseke W4ZFL. UFOs are a topic I've been fascinated with since the early '50s, when I was first

Continued on page 62

Low Power Operation

Michael Bryce WB8VGE
P.O. Box 508
Massillon OH 44648

This month, I have some more odds and ends for you. These circuits and tidbits may help you enhance the performance of your QRP equipment.

A&A Engineering RIT modifications

The first project comes from John Best, Sr. WA1YIH. John took the RIT circuit for the MFJ QRP monobanders and modified it to work with the Gary Breed K9AY/A&A Engineering 30 meter rig. The original circuit appeared in *73's* "QRP" column for November '95. Here is John's modification:

"I modified the RIT circuit for the MFJ rigs to work with my A&A Engineering QRP transceiver. I used a Radio Shack IC board, 276-159, and ugly construction.

"To modify the rig, you have to remove the fine-tuning control. The fine-tuning control connects to the main tuning circuits. The wire that goes from the main tuning to the fine-tuning is removed and hooked to R2 (the 470 ohm resistor). The wiper of the fine-tuning is grounded. One side of the fine-tuning is connected to pin 2 of the 4066. The rest of the circuit is self-explanatory."

John reports that he gets approximately 800 Hz offset on either side of the RIT control center position. John's RIT indicator is pretty simple. He used a dual-colored LED, Radio Shack™ #276-025, and a DPDT switch.

John says, "I use the green as a rig power indicator as well as RIT off, and the red for RIT on."

With the fine-tune control out of the circuit, I would suggest you replace the original single-turn tuning control with a multi-turn pot. I've seen these units listed as surplus for under 10 bucks. Also, if you favor one segment of the band over another, I would change the voltage divider used to drive the VXO. Expanding the range within a segment will give you super-smooth tuning. On the downside, it would be real slow to go from one end of the desired segment to the other.

Wimpy 386 audio

If you've ever built a QRP rig, it's a good bet you've used the LM386 audio amplifier. It's almost a standard part—every QRP builder should have one in his or her junk box.

However pleased you may be with your home-brewed or commercial rig using an LM386 for the audio output stage, you can be in for a shock if you compare it to another rig. Side by side, with the same LM386 audio driver, some QRP rigs are much louder. I noticed this several years ago at the annual Dayton HamVention QRP forum.

We were playing with a new commercial rig. The audio was very wimpy. In fact, with a room full of people fixing the world's problems, you could hardly hear anything from the speaker. The guy who had just purchased the rig mentioned that the reason was the LM386. "There's not much audio inside an LM386." At that time someone looking over our shoulders said his rig had more than enough audio, so much in fact you could easily hear it in this room full of people.

So, we connected his rig up to the same antenna. We tuned in a station on 40 meters. With the volume control up only to half-way, someone across the room yelled at us to "Turn that damn thing down so we can talk." Indeed, the LM386 in his rig was really spitting out the audio!

Now, there are only so many ways you can configure a LM386 audio amplifier. You can select the amount of gain produced by swapping out a capacitor, but you can't generate more gain than the device will produce. Since we were using the same antenna, that ruled out any gain produced by the RF section. Both rigs were based on a direct conversion receiver, so almost all of the gain of the rig had to be in the audio chain. Everyone seemed to narrow the difference down to audio preamplifiers before the LM386. That was several years ago. Here's some info I have since dug up about this unique chip.

First, if you have a choice, get the LM386 made by National Semiconductor. Although the LM386 is made by a wad of companies, the National devices seem to work better.

Everyone I've talked with has been under the that assumption the LM386 is a 1 watt audio amplifier, but it actually comes in a variety of different power levels. Fact is, some are rated for only 300 mW! You can tell by the number on the chip. An LM386-1 is rated for 250 mW, the LM386-3 is rated for 500 mW, while the LM386-4 is rated at 700 mW. National spec sheets say normal power output for this version is close to 1,000 mW.

There are two other problems with LM386 designs. One is

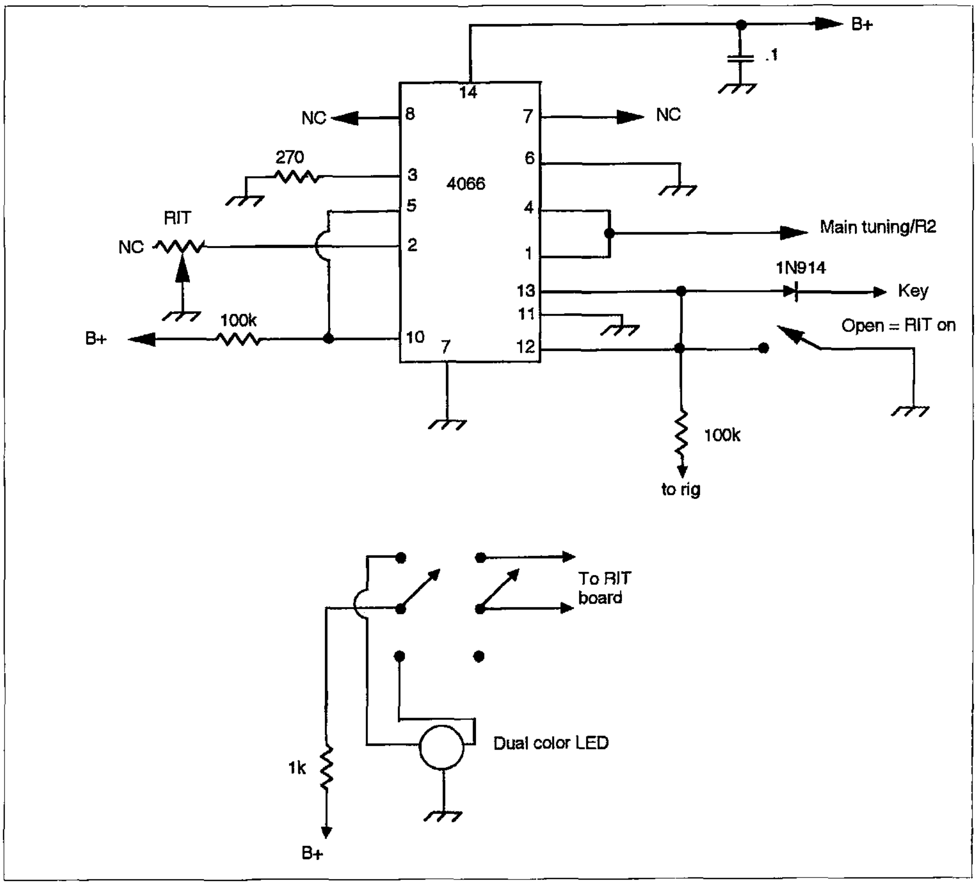


Fig. 1. WA1YIH's modified RIT circuit.

over-driving the amplifier. This is a very common problem, especially with home-brewed equipment. Let the gain of the amplifier do its job—you don't need to apply 200 mW of drive! Design your audio preamplifier so it provides the proper level for the LM386.

Another problem with some LM386 designs is a tendency to oscillate, or "motorboat." With rare exceptions, this can be cured by increasing the value of the decoupling capacitor on the VCC line of the LM386. It's also good practice to have this capacitor mounted as close as possible to the chip. Many designs show the value of this decoupling capacitor at about 220 µF. Increasing the value to 470 or 1,000 µF will usually do the job.

In really stubborn cases, a small value resistor, usually 10 or 22 ohms, may be inserted in series with the VCC line feeding the LM386. A 1/2 watt resistor should be used instead of the junk box 1/4 watt device.

An all-too-often overlooked item when fixing a wimpy LM386 is a poorly regulated power source. If your rig is running from a battery, and there is an internal 7812 regulator feeding the LM386, the regulator won't have enough overhead to regulate. This will cause the voltage supplying the LM386 to wander about. You can prevent this several ways.

First, you can run the LM386 from the input side of the regulator, assuming the input (supply) voltage is between 12 and 14 volts DC.

If this is not possible, you can use a voltage regulator with a lower voltage rating. A 7810 will have the necessary overhead when using a 12 volt supply, but just barely! A 7808 would be ideal, provided your circuit will operate at 8 volts. There *is* a 7809, but it's hard to come by.

If you need to increase the voltage of a 7808 regulator, there are two fixes. First, you can put a diode in series with the ground pin. For each diode, you will raise the output by .7 volts. Or, you can use a resistor connected to the ground pin. In both cases, you raise the ground pin slightly above ground, which causes the output voltage to increase. I should mention that neither way is the preferred method to increase the voltage of a three-terminal regulator. It's always best to specify the correct voltage regulator for the circuit under design.

Last month's schematics

Some of the schematics were missing from last month's column. Moving into a micro apartment has really put the screws to me. As things begin to settle down, I'll be able to get back into my routine. If you are interested in some of the missing schematics, drop me a line. Do be sure to send letters to my new address, P. O. Box 508, Massillon, Ohio 44648.

Out of all this madness, a 100 percent solar home will be constructed. A 4 kW peak solar array is planned. Also planned is a 65-foot free-standing tower, complete with some real antennas! The best part of it all is that by the time I'm done, the sunspot cycle should be taking off. Talk about good timing! 73

LETTERS

Continued from page 60

licensed as WN4ZFL and W4ZFL in Pensacola, FL, as a teenager. I teach foreign military personnel at the Defense Language Institute English Language Center at Lackland AF Base and last week I was introduced to a Turkish AF officer there who had an encounter with a UFO. About five years ago, he told me, he was in the front seat of an F-104 when his instructor in the back seat called his attention to an approaching disc-shaped bright light. It continued to approach them, and when it was quite close his instructor decided to initiate the ejection sequence. Before he was ejected, after being told to prepare for ejection in 10 seconds, he saw the UFO veer away from them, but too late to save the aircraft. The approach of the UFO to their aircraft was, fortunately for the pilots involved, witnessed by personnel in a control tower close to the runway.

Other DLIELC students have told me of UFO encounters over the years. While teaching all the military officers attached directly to the Colombian president (his personal pilot, security chief, protocol officer, a Navy liaison officer, and the colonel in charge of "La Casa Militar") a number of years ago at the Presidential Palace in Bogota, Colombia, I asked these officers one day when we were all together if they thought the most likely explanation for the more reliable, more substantial, credible reports was that we are being visited by extraterrestrials. Going around the conference table with this question I was fascinated when each officer responded with a "Yes." That's the only military group I've taught over the past 30 years that was so unanimous when asked such a question.

Continued on page 81

Number 62 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the June issue, we should receive it by March 31. Provide a clear, concise summary of the essential details about your Special Event.

FEB 8

CHARLESTON, SC The 24th annual Charleston Hamfest and Computer Show will be held at Stall H.S. near I-26 and Ashley Phosphate Rd., in North Charleston. Tailgating allowed. Talk-In on the WA4USN Linked Rptr. Sys. 146.79(-) Rptr. aboard the *USS Yorktown* and the 145.25(-) Rptr. near Summerville. Tickets will be sold Sat. morning at the door; $5 for adults. Children under 12 admitted free. Pre-reg. tables are $8 per 8 ft, $10 at the door as long as they last. Make check payable to *C.A.R.S. Hamfest Committee*, and send with an SASE, to *Jenny Myers WA4NGV*. Table reservations must be received before Jan. 24th. VE Exams on site starting at 12 Noon. Walk-ins. Bring original and copy of your license, any CSCEs you have, and two IDs, one with a photo. For exam info, call *Ed Frank KC4OOZ, 610 Longstreet Cir., Summerville SC 29483. Tel.(803) 871-4368;* or *Doc W4MUR, (803) 884-5614* or E-mail: *efrank@charleston.net*. The Hamfest contact is *Jenny Myers WA4NGV, 2630 Dellwood Ave., Charleston SC 29405-6814. Tel. (803) 747-2324,* or E-mail: *brycemyers@aol.com*. VE Exams are also given monthly on each 3rd Saturday, at Trident Tech College, Rivers Ave., North Charleston, Bldg. 630 at 9 AM. Contact *Ed Frank KC4OOZ, (803) 871-4368.*

DEARBORN, MI The Michigan Antique Radio Club will host its Swap Meet at the Armenian Hall on Ford Rd. Open to the public 8 AM-Noon. Adm. $2 per person. A Silent Auction, Equip. Contest, and a Donation Auction will be featured. Contact *Jim Clark at (517) 349-7187.*

FEB 9

MANSFIELD, OH The Mansfield Mid*Winter Hamfest/Computer show will be held by the InterCity ARC, Inc., at the Richland County Fairgrounds in Mansfield. Doors open at 7 AM. Tickets $4 in advance, $5 at the door. Tables $9 in advance, $12 at the door, if available. Advance orders must be received and paid by Jan. 13th. Send requests, payments, and SASE to *Pat Ackerman N8YOB, 63 N. Illinois Ave., Mansfield OH 44905;* or phone *(419) 589-7133 after 1 PM EST. Talk*-in on 146.34/.94 W8WE.

FEB 13 and 27

FORT WORTH, TX The Lockheed ARC and the Kilocycle Club of Ft. Worth will sponsor VE Exams for all classes at the Lockheed Rec. Area Facility located at 2400 Bryant Irvin Rd. Exams start at 7 PM. G.R.D.L. testing done by appointment only. Call *Ted Richard AB5QU at (817) 293-6745.*

FEB 14–16

ORLANDO, FL The OARC of Orlando will host the Orlando HamCation and Computer Show, and ARRL North Florida Convention at Central Florida Fairgrounds. Set up Fri. 9 AM–5 PM; open to the public Fri. 5 PM–9 PM, swap tables only. Sat. 9 AM–5 PM and Sun. 9 AM–4 PM. 150 commercial exhibits. Largest tailgate area in FL. RV overnite parking $16. Adm. $6 advance, $9 gate. Free parking. Swap tables $25/Tailgate $15 all 3 days. For advance tickets and info, contact *Orlando HamCation, P.O.*

Box 547811, Orlando FL 32854. E-mail: *kd4jqr@aol.com.* Web Page *www.cycat.com/users/oarc.* Forums: NASA Astronaut, Slide/Photo Exhibit of Lightning Storms, ARRL, APRS Demo by Bob Bruninga, WX Downloads, WX Equip. for the Home, Shortwave Listening by Bob Grove, pub. *Monitoring Times*; Build a VHF SWR Meter; Grounding for Lightning; Antenna Workshop; Radio Testing, and more.

FEB 15

HARRISBURG, PA The Harrisburg ARC will hold its Winter Hamfest 8 AM-Noon at the Oberlin Fire Hall, Oberlin PA. General adm. $2. Inside Tables $8 ea. Tailgating $1 per space. Dealer Set up at 6 AM. VE Exams start at 9 AM. Talk-in on 146.76. For info and table reservations, phone the *HRAC AnswerLine* at *(717) 232-6087.*

HORSEHEADS, NY The ARA of the Southern Tier will present a Hamfest at the New York State Armory, 128 Colonial Dr., 7 AM-3 PM. There will be dealer displays of new equipment and an indoor Flea Market area. Tables will be available on a first-come basis. VE Exams start at 9 AM. Contact *Jack Slocum, 410 Shelbourne St., Horseheads NY 14845. Tel. (607) 739-4866.*

TRAVERSE CITY, MI Cherryland ARC will hold their 24th annual Swap-n-Shop at Immaculate Conception Middle School, 8 AM–Noon. VE Exams following the Swap at 1 and 4 PM. Talk-in on 146.86. For more details call *Joe W8TVT* at *(616) 947-8555*, or *Chuck W8SGR* at *(616) 946-5312.*

FEB 16

BRIGHTON, CO The Aurora Rptr. Assn. will hold its 15th annual Swapfest at the Adams County Fairgrounds, 9755 Henderson Rd., 8:30 AM–2 PM. For details, contact *Chris Knauer KB9CCR, (303) 403-1883;* or E-mail at *cknauer@skywam.org;* or write to *Aurora Repeater Assn., c/o Janice Christopherson, 4376 S. Argonne Way, Aurora CO 80015.*

NEW WESTMINSTER, BC, CANADA The Burnaby ARC, VE7RBY, will hold the "Burnaby ARC 10th Annual Fleamarket" at New Westminster Armouries, 6th St. and Queens Ave., 10 AM–2 PM. Set up at 9 AM. Talk-in on VE7RBY 145.35(-) or 442.85. For info and tables, phone between 7 PM–9 PM PT: *Harry VE7HNC, (604) 530-3962; Graham VE7ABC, (604) 530-1907; packet VE7ABC@VE7KIT;* or *Rick VE7HRL, (604) 464-0768.*

FEB 22

LAPORTE, IN The LaPorte ARC "Cabin Fever Hamfest" will be held 8 AM–2 PM at LaPorte Civic Center. Adm. $4; tables $5 ea. Talk-in on K9JSI 146.610 (131.8PL), 443.900 (131.8PL) and 146.520 simplex. For details contact *John N9ROH, LPARC, P.O. Box 30, LaPorte IN 46352.*

MILTON, VT The Radio Amateurs of Northern Vermont will sponsor the Northern Vermont Winter Hamfest 8 AM–3 PM at Milton H.S., Route 7. Features include Flea Market, Auction, Dealers, Book Sales, Forums, and more. VE Exams will be given at 9 AM and 2 PM. Commercial Exams at 2 PM. Adm. $3, free for under 18 years. Tables are free while they last. Call for large setups. Talk-in on 145.15 Rptr. Contact *W1SJ* at *(802) 879-6589. E-Mail: wb2jsj@vbi.champlain.edu. Web Site: http://www.together.net/~fflynn/milton.html.*

FEB 23

CUYAHOGA FALLS, OH The Cuyahoga Falls ARC will host its 43rd annual Hamfest at Emidio's Party Center, 48 Bath Rd., 8 AM–2 PM. Free parking. Talk-in on 147.87/.27 W8VPV. Adm. $4 advance, $5 at the door. Reserve tables by Feb. 8th, $8 advance, $10 at the door, if available. Contact *Bob Recny N8SQT, 496 Orlando Ave., Akron OH 44320-1243.* Tel. *(330) 864-5810;* FAX *(330) 864-5879;* E-mail: *hamfest @neo.lrun.com.*

LIVONIA, MI The Livonia ARC will present its 27th annual Swap 'n' Shop, 8 AM–3 PM, at the Dearborn Civic Center, Dearborn MI. VE Exams. Talk-in on 144.75/.35. For info, send a 4x9 SASE c/o *Neil Coffin WA8GWL, Livonia ARC, P.O. Box 51532, Livonia MI 48151-5532;* or call the Club Phone Line, *(313) 261-5486.*

MAR 1

ABSECON, NJ The Shore Points ARC will sponsor its 15th annual hamfest, "Springfest '97" at Holy Spirit H.S. on Route 9, starting at 8 AM. Set up at 6:30 AM. Flea Market, outdoor Tailgating (weather permitting). Talk-in on 146.385/.985 PL 146.2 Hz. For info, write to *SPARC, P.O. Box 142, Absecon NJ 08201;* or call/FAX *(609) 653-1987.*

PARSIPPANY, NJ The annual North Jersey Hamfest, sponsored by Split Rock/West Morris Radio Clubs will be held at the PAL Bldg. on Smith Rd. Talk-in on 146.985/.385. For info or reservations, call *Bernie WB2YOK*, Fax/Voice *(201) 584-5399 24 hrs.;* Online *75503 ,3221@compuserve .com.*

MAR 15

KNOXVILLE, TN The Shriners of the Kerbela AR Service will sponsor the Kerbela Hamfest at the Kerbela Shrine Temple, 8 AM–4 PM. Adm. $5. Indoor vendor tables $8 ea., plus adm.; outdoor tailgating spaces are $3 plus adm. Set up at 4 PM–9 PM Fri, and 5 AM–8 AM Sat. Talk-in on 144.83/145.43, or 146.52 simplex. Smoking in designated area only. Contact *Paul Baird K3PB, 1500 Coulter Shoals Circle, Lenoir City TN 37772.* Tel. *(423) 986-9562.*

SPECIAL EVENT STATIONS

FEB 8–10

ST. PETERSBURG, FL The QCWA Golden Anniversary QSO Party will be open to all Amateur Operators, world wide, 1400 UTC Feb. 8th -0600 UTC Feb. 10th; and 1400 UTC Mar. 8th–0600 UTC Mar. 10th. For rules, send request and a business size SASE to *J. Frederick Strom K9BSI, Activities Mgr., 233 34th Ave. North, St. Petersburg FL 33704-2241.* All logs must be received no later than Apr. 1st, 1997. Mail Feb. logs to *Arthur Monsees W4BK, 420 Bay Ave., Apt. 1521, Clearwater FL 34616.* Mail Mar. logs to *Donald Bice W4PCO, 5511 18th Ave. North, St. Petersburg FL 33710.*

FEB 14, 15, 16

MARQUETTE, MI Hiawatha ARC K8LOD Up 200 Sled Dog Race. 20–80 meters, General. For a certificate, send an SASE to *N8BGA, 21 Smith Lane, Marquette MI 49855.*

FEB 15–16

ALEXANDRIA, VA The Mount Vernon ARC will operate K4EC 1600Z–2200Z Feb. 15–16 to commemorate George Washington's birthday. Operation will be in the lower General 80–15 meter phone subbands and in the Novice 10 meter subband. For a certificate, send your QSL and a 9x12 SASE to *MVARC, P.O. Box 7234, Alexandria VA 22307.* For more information, contact *Mary Pat Nowack KE4QWK, 703-684-8793.*

Communications Simplified, Part 14

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

Although we can calculate the VSWR once we know the load impedance, in practice it is a lot easier to measure it directly. The two most common instruments used are an inexpensive SWR bridge and a much more expensive (and more accurate) device called a through-line wattmeter. The Bird ThruLine meter is the most common brand name of the latter. Both of these work on pretty much the same principle; **Fig. 1** shows how the SWR bridge works.

The meter has a metal trough running from one end of the case to the other, with the transmitter and antenna connectors at opposite ends of the case. Running through the trough are the three wires labeled **A**, **B**, and **C** in **Fig. 1.**

Wire **A** carries the signal from the transmitter to the antenna. Wires **B** and **C** are close to it, but not touching; they are called *sensing wires*.

Let's look at wire **B** first. Because **B** is right next to **A**, there is a small capacitance between the two. This causes wire **B** to pick up a small amount of signal from **A**. But as current goes through wire **A** to the antenna, it also generates a small magnetic field. Wire **B** is in that field, and therefore picks up a small amount of signal from the magnetic field as well. The polarity of the signal picked up through the capacitance does not depend much on which way the signal is going, but the polarity of the inductively coupled signal does. For an outgoing signal from the transmitter to the antenna, the two voltages add, whereas for the reflected signal, they cancel. Diode D1 therefore gets a signal proportional to the outgoing or forward signal, but ignores the voltage from the reflected signal. In the same way, diode D2 gets a signal proportional to the reflected signal. The two voltages are then rectified and filtered by the two diodes and capacitors, and fed through the FWD-REV switch to the meter.

The secret to the measurement is in the meter's scale calibration, shown in **Fig. 2**. To use the meter, we first connect it to the transmitter, set the FWD-REV switch to the FWD or Forward position

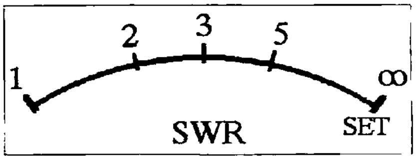


Fig. 2. SWR bridge meter scale.

and turn on the transmitter. Then we set the CALibrate control so that the meter reads full-scale; there is usually a small SET mark at the right end of the scale. Regardless of how much power or voltage the transmitter is sending out, this calibrates the SWR bridge to that level.

The next step is to switch the FWD-REV switch to the REVerse setting (without touching the CALibrate control). If all of the power is reflected from the antenna, indicating an infinite VSWR, the reverse voltage is the same as the forward voltage, and thus the meter will read full-scale. So the full-scale end of the scale reads infinity. If, on the other hand, the antenna is a perfect match, then the reverse voltage is zero and the VSWR is 1; hence the left end of the scale reads 1.

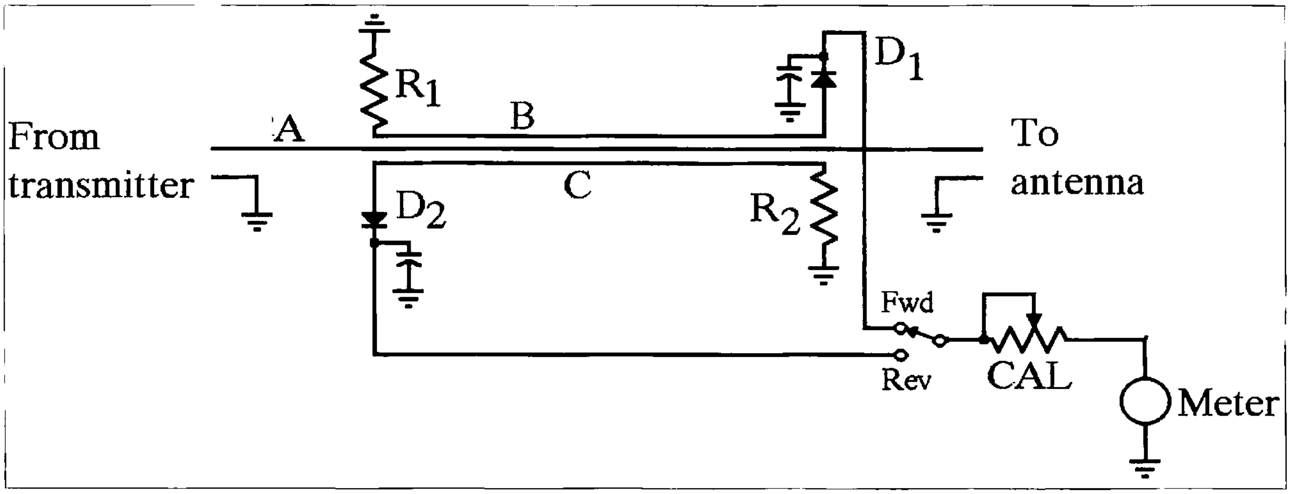


Fig. 1. An SWR bridge.

At the midpoint, the reverse voltage is exactly half of the forward or outgoing voltage. For example, if the outgoing signal is 10 volts and the reverse is 5 volts, the VSWR is then:

$$VSWR = \frac{Vmax}{Vmin}$$

$$= \frac{10 + 5}{10 - 5} = \frac{15}{5} = 3$$

so the midpoint reads 3. Since VSWR above 3 is generally considered quite bad, the right half of the scale is usually colored red.

A typical SWR bridge costs $20-$30, and covers a fairly limited frequency range. For more accurate measurements, many professionals use the Bird ThruLine Wattmeter. This meter works on the same principle, but instead of having two separate sensing wires, two diodes, and a switch to select them, there is one sensing wire and its diode, mounted in a rotating assembly called a *slug*. The slug has a printed arrow on it, and you rotate it to measure the forward or reverse voltage. The meter is calibrated in watts, rather than in VSWR. Because the reading depends on frequency and power, Bird makes several dozen different slugs for various power and frequency ranges. This makes the power readings quite accurate, but the disadvantage is that you have to calculate your own VSWR from the forward and reverse power readings. (In practice, many technicians take the easy way. If the forward power is "big" and the reverse power is "small," then they are happy!)

One application—a waveguide

The idea that a line shorted at one end can appear open at the other, and vice versa, has some interesting applications. Consider microwaves, for instance.

Microwaves are radio waves that have a very high frequency, typically more than several gigahertz. This also means that they have a very small (micro) wavelength. For example, a signal at 10 GHz has a wavelength of about 1/4". At these frequencies, signals travel only on the surface of wires, not inside them; this is the so-called *skin effect*. A much more severe problem is that most insulators do not

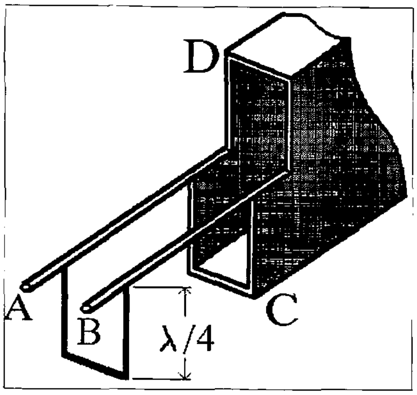


Fig. 3. Making a waveguide.

work very well at these frequencies—they are too lossy. So it is difficult to build a cable to carry them any great distance.

But suppose you used a pair of uninsulated wires (**A** and **B** in **Fig. 3**) held up by a wire loop, as shown at the left of the figure. If the wire loop was exactly 1/4 wavelength long, then its top would appear open even though the bottom is shorted. In other words, a perfect insulator made of metal!

In practice, this is a tad tough to fabricate. But since you can place these wire loops as close together as you want, there is no reason why they cannot be made into the continuous trough shown as **C** in **Fig. 3**. To prevent rainwater from collecting inside, we place another identical trough (**D**) above it, giving us a rectangular pipe called a *waveguide*. The signal simply travels along the inside edge of the pipe, roughly in the middle of the long side, which is now 1/2 wavelength long (1/4 wavelength from the middle toward each end).

The frequency at which the long side of the waveguide is exactly a half-wavelength long is called the *critical frequency*. Frequencies lower than the critical frequency can't make it through the waveguide because the distance from the midpoint to the edge is too small—they get shorted out by the edge of the loop. But frequencies *above* the critical frequency can make it through, simply by traveling a bit closer to the edge.

Most waveguides are fairly small. But if you've ever driven through a long tunnel, you've been inside a large waveguide. You may have noticed that your AM radio goes dead almost as soon as you enter the tunnel, whereas your FM radio only gradually fades out as you go in. The reason is that the typical tunnel is too small to let AM broadcast signals through. Since the typical AM station has a wavelength of 600 feet or more, the tunnel would need to be more than 300 feet (a half wavelength) in diameter to let the signal in. So AM signals simply don't make it into the tunnel. FM broadcast station frequencies, on the other hand, have a wavelength of about 10 feet, so even the smallest tunnel will let them through.

Tunnels don't really make good waveguides, though, because they are not made of a good conductor. Underwater tunnels are made from short sections of steel pipes, with waterproofing compound joining them so they do not leak. This waterproofing insulates the sections from each other, so FM signals, though they get partway into the tunnel, cannot really travel all the way through. Still, it makes an interesting example.

The idea of radio waves getting through holes is similar. For example, if you wanted to shield a room to prevent radio waves from getting in or out, you could completely encase it in a solid sheet of copper. But this isn't necessary—you can use copper sheet with holes in it, as long as the holes are substantially smaller than 1/2 wavelength. Likewise, the metal sheet covering the window in a microwave oven door has holes that we can see through. But the holes are much smaller than the microwave wavelength, and so the microwave energy cannot get through.

Another application—a stub

A stub is simply a short piece of transmission line. For example, suppose you are trying to receive a particular station, but another strong nearby station is causing interference in your receiver. You therefore decide to filter out the interfering station and keep it out of your receiver.

The simplest (though not necessarily the best) solution is to connect a 1/4-wavelength stub in parallel with your receive antenna. If you leave the far end open, the end connected to your antenna terminals will act as a short and short out the interfering signal. You must keep in mind the velocity factor of the cable to calculate the correct length; in practice, it's probably a good idea to cut the cable a bit too long, and then cut off tiny pieces while observing the interference, until the length is just right.

Transformers for impedance matching

Quite often you need to match one impedance (for example, a 75-ohm cable) to another (such as a 300-ohm antenna). This particular case is a common one with TV antennas; many TV antennas are designed for 300-ohm twin-lead, but used with 75-ohm coax cable.

In this example, there is more than just impedance matching at stake. Coax cable is unbalanced (the signal travels on the inner wire, while the outer shield should be at ground potential), whereas most TV antennas are balanced (both connections carry the signal, but out of phase with each other.) Such transformers are also often called *baluns*, because they connect between a balanced and an *un*balanced device.

Matching transformers are readily available just for this purpose. The ones for TV use are cheap because only low power is involved; the ones for transmitting applications must handle the full transmitter power and so they are bigger and more expensive.

Fig. 4 shows the wiring of a typical TV balun transformer designed to match 75-ohm coax to a 300-ohm balanced antenna. The transformer consists of two wire windings, wound near or over each other. Since the impedance ratio of the two windings of a transformer is the square of the turns ratio (the ratio of the number of turns on the primary and secondary), for a 300-to-75-ohm impedance match (a ratio of 4-to-1), we need a turns ratio of 2-to-1. So the 300-ohm side of the transformer has twice as many turns as the 75-ohm side.

The matching transformer in **Fig. 4** has the advantage of being usable over a wide range of frequencies. But if you only need to match at one specific frequency, you can use a length of transmission line instead.

We've now learned that a 1/4-wavelength cable can change a short into an open, or vice versa. But there's more to it than that. If the characteristic impedance of the cable is Z_0 and the load on its output is Z_{load}, then the impedance Z_{in} you see looking into the cable is:

$$Z_{in} = \frac{Z_o^2}{Z_{load}}$$

Notice that this makes sense: if Z_{load} is an open (infinite impedance), then Z_{in} is a short (zero impedance). If Z_{load} is a short (zero impedance), then Z_{in} is an open (infinite impedance). And if Z_{load} is equal to Z_0, then Z_{in} is also Z_0. So far so good.

But we can take this equation and rewrite it as:

$$Z_o^2 = Z_{load} \times Z_{in}$$

$$Z_o = \sqrt{Z_{load} \times Z_{in}}$$

So if we want to connect a load Z_{load} of 300 ohms to a 75-ohm input Z_{in}, all we have to do is connect a 1/4-wavelength line between them whose characteristic impedance is:

$$Z_o = \sqrt{Z_{load} \times Z_{in}} = \sqrt{300 \times 75}$$

$$= 150 \text{ ohms}$$

With the 300-ohm load on a 1/4-wave section of line having a 150-ohm characteristic impedance, the input into the line will look like 75 ohms, a perfect match.

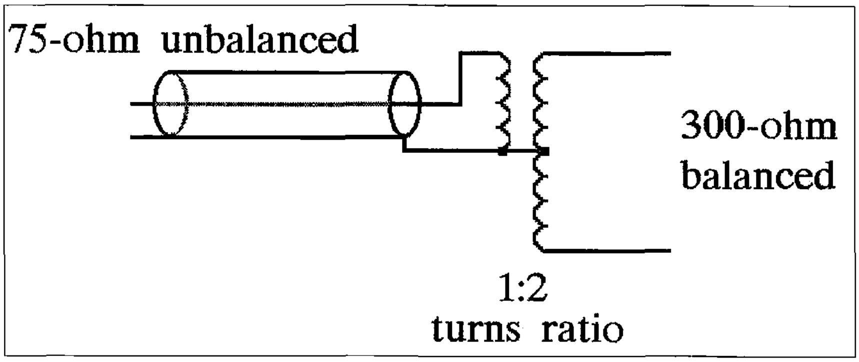


Fig. 4. 300-75-ohm balun.

There are two catches, of course—this will only work at the one frequency that the line is cut for, and you cannot mix a balanced line with an unbalanced line. So this is totally unusable for the typical TV application. But it is perfectly suited for those single-frequency applications in communications.

Last thoughts

There is one other idea that should be covered, but that didn't somehow fit into any of the previous sections. In a balanced transmission line (such as the 300-ohm twin lead used in TV antennas), it's obvious that the signal travels along both conductors. But many people believe that in coax the entire signal travels only along the inside conductor, and the shield is there only for the ride, so to speak—to keep outside signals out, and inside signals in. Not so.

If you place a load, such as a resistor, at the end of a line, the only way to get a current to flow in the resistor is to have both ends of it connected to *something*. Whatever current flows into the resistor from the center conductor must flow out the other end, and into the shield. So the shield takes an active part in the process. This will be an important concept in the next article in this series, when we talk about antennas. An antenna cannot connect just to the center conductor of the coax because then the current has nowhere to go. There must be a solid connection from the coax shield to some active part of the antenna so that current can return along the shield.

Summary

Our treatment of transmission lines has been a very brief, simplified one. There's a lot more to this subject. For one thing, we've assumed that our transmission lines have no loss. That's not true; the loss changes the results somewhat, and usually must be taken into account.

More important, even though we've used the symbol Z in our calculations to keep things general (and to use the same symbols as most other books and articles), we've ignored the fact that these are really impedances—we've made believe that all the Z's have been pure resistances. That makes things simple, but is not exactly realistic. But at this point I will use the standard excuse you'll find in many books: "More advanced treatment is beyond the scope of this article."

QRP T-R Circuit

It's simple and versatile.

Mark L. Meyer WUØL
14153 West First Drive
Golden CO 80401

Have you been looking for a simple T-R circuit for your QRP transceiver project? I too was faced with this problem recently. I wanted something that was simple, would work for several different bands, and would not add significantly to battery drain.

Most of the current crop of QRP designs and kits are of the single-band variety and use the L-C series traps method of automatically isolating the receiver input from the antenna when the transmitter is keyed. This is a great and simple method; however, the L-C network is specific for each separate band. I was working on a multibander so I wanted a circuit that would work for all bands without modification or duplication. I also wanted near QSK performance for quick changeover, not between CW characters but between words or pauses. I decided what I really needed was a reed relay circuit that would utilize a normally closed contact to keep the antenna connected to the receiver with no current flow at all during receive periods.

Reed relays have very fast switching times and also have high coil resistance. This means low current flow, especially compared to what a rig draws anyway on transmit. These relays typically draw only 15 milliamperes or less operated at 12 VDC.

The circuit

Fig. 1 shows the circuit I developed. The circuit is activated from the key line on your rig. This is the line that goes to ground potential when your rig is keyed. This comes straight from your key jack; either your hand key or your keyer, when activated, causes this line to go to ground. This in turn causes a keying transistor to turn on, applying 12 volts to various parts of your transmitter circuitry.

In **Fig. 1**, nearly the same thing happens as in your transmitter. When A is grounded, Q1 turns *on*. This applies +12 volts to the coil of RLY1. Since this is a very fast relay, it immediately opens the contact separating the receiver from the antenna. Note that the Q1 circuit does not contain any timing or shaping capacitors like your switching transistor in your transmitter circuit does. This is because we want RLY1 to pick up immediately before the transmitter is turned on. Otherwise we may pump some transmitter power into the receiver, causing some serious problems!

Q1 also applies voltage to capacitor C1 through resistor R1, causing it to charge. This is the dropout timing circuit. When Q1 returns to normal, C1 discharges through R1 and the relay coil. C1 and R1 are chosen to keep the relay pulled in through a normal string of dits and dahs, but to drop out on pauses or between words.

If you wish a longer dropout period, simply increase C1 to 330 µF or 470 µF. Reduce C1 for a quicker QSK type response. R1's purpose is to make sure that RLY1 receives full voltage immediately (not dragged down by charging C1) upon energization, so pickup is quick.

The relay

The relay specified has a 1,000 ohm

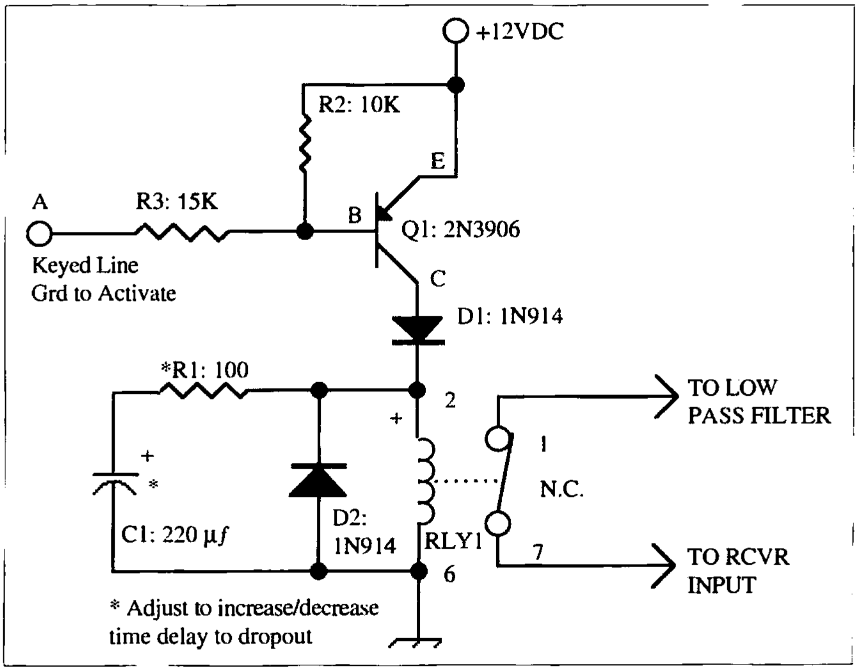


Fig. 1. T-R antenna changeover circuit.

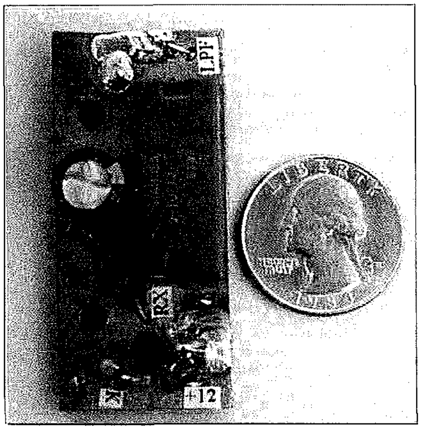


Photo A. The T-R board shown before installation, resting on top of the case for the rig.

coil. Energized, it will draw about 12 milliamperes. I am currently using a relay with a coil that measures 800 ohms and the values specified are right for my normal keying speeds. Feel free to experiment with whatever relay you chose by varying C1 and R1, but do not lower R1 very much because you want RLY1 to pick up immediately.

A word about reed relays– they come a several different forms. Most have one normally open contact. You want one with a normally closed contact for this circuit, so check it out with your ohmmeter. Also, some reed relays have a built-in suppression diode (D2). In this case you don't need to include D2 in your circuit (but it won't hurt if you are unsure). D2 provides a safe path for the energy stored in the coil to dissipate when the coil is de-energized. Some reed relays are polarized. Be sure the (+) mark is towards Q1 if the relay you use has a polarizing mark.

Test your relay by connecting your ohmmeter across the contacts and energizing the coil from a 12 volt supply. Watch for polarity before you connect the coil to the supply. When you energize, the contact should open and the meter reading go from zero to infinity.

Reed relays have long life expectancies. The relay specified is good for 100 million operations when switched *dry*. (That *dry* means when the contacts do not have to switch current other than very small signal values, like we are doing.) For the worst-case scenario, if you transmitted 24 hours straight every day for an entire year, at 15 wpm, using full QSK, you would just barely exceed 100 million operations. For us less active

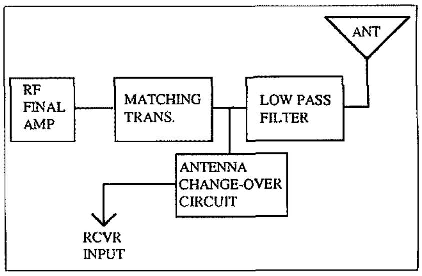


Fig. 2. Hookup.

operators, this relay should have a long life span.

Construction and testing

All parts other than the relay are garden variety. Just about any small PNP silicon switching or small signal transistor will work for Q1. The diodes are silicon small signal or even small rectifier diodes. C1 should have a 25 volt rating to be safe.

I built my T-R circuit on a little scrap of printed circuit board measuring about 2 inches by 1 inch. I just gouged out some isolated pads for each connection pad and drilled holes with my Dremel™ tool. A small perfboard or Radio Shack™ pre-drilled project board (RS #276-159) will work great. The Radio Shack board will accept the relay pins directly, making things easy.

Hookup and testing are easy. Connect a 12 volt supply to the circuit. Again hook up the ohmmeter across the contacts. Ground "A" and see that the contact opens immediately but closes back after a short delay. You will need an analog ohmmeter to see the pickup and delay because most digital meters take a while for the reading to change. Then hook a jumper from your key line in your rig to "A." Send a string of dots and dashes. You should aim to have the relay stay picked up between characters but to drop out on pauses. If your operating habit is such that you would like the relay to hang in between words, increase C1 substantially. Otherwise small changes will take care of things.

Be sure that when messing with your rig you have a dummy load connected or you remove the 12 volt supply from the output transistor. You wouldn't want to blow up the final because you didn't have an antenna connected. Now build the circuit into your transceiver. Connect one side of the relay contact to the spot between your low-pass filter and the

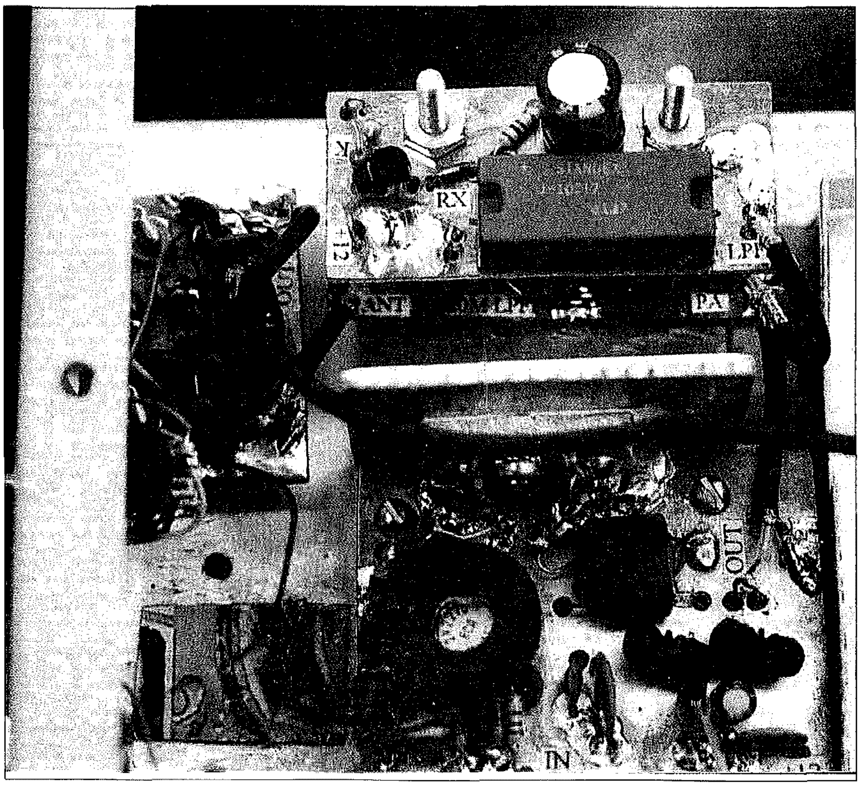


***Photo B.** The T-R Board (upper center) installed in a portable rig. Directly below are the PA and driver boards. The low-pass filter is located on a board underneath the T-R board.*

power amplifier matching transformer, or between the low-pass filter and the power amplifier itself if no matching transformer is used. The other side goes to the receiver input. That's it!

You now have a very simple circuit that works great. It works for any of the HF. bands without modification, and you learned a little about circuit design in the process.

Parts List			
Relay	RLY1	Reed relay with Normally Closed contact	Newark #65F2276 or Mouser #433-D31B510
Diodes	D1,D2	General purpose	1N914 or 1N4148
Resistors	R1,R2,R3	1.4 watt	
Transistor	Q1	Any small general purpose PNP	2N3906
Capacitor	C1	220 uF, 25V	

Elegant Rotating—Revisited

Continued from page 20

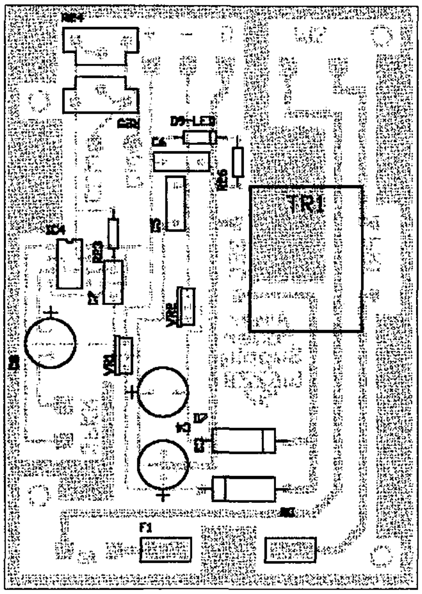


Fig. 7. *Component side of the power supply board and placement of the components (not to scale).*

Parts for Aimer Board	
R1	25k linear pot
R12, R14, R19, R21, R22	1k, 1/4 watt
R2, R11, R13, R18, R20	10k, 1/4 watt
R16, R17	15k, 1/4 watt
R10, R15	75k, 1/4 watt
R3, R6	100k, 1/4 watt
R4, R5	1 meg, 1/4 watt
R7, R8	20k PCB pot
R9	1 meg PCB pot
C1	22 µF, 25 volt
C2	5 µF, 25 volt
D1, D2, D3, D4	1N914
D5, D6	LEDs, any color
IC1, IC2, IC3	LM311
Q1, Q2, Q3	2N2222 NPN trans.
K1, K2, K3	Radio Shack #275-214 4PDT relay, 12 VDC coil
J1 - J9	Wire jumpers
Parts for Power Supply and Audio Oscillator	
TR1	12 volts, 300 mA, RS #273-1385
Voltage regulator	+12 volts, 7812
Voltage regulator	-12 volts, 7912
D7, D8	1N4001 50 PIV
C3, C4	1,000 µF, 25 volts
IC4	LM555
C5, C6	0.1 µF
C7	0.1 µF, 25 volts
C8	10 µF, 25 volts
Miscellaneous Parts	
1/8 amp fuse and holder, appropriate switch and power cord	

***73* wants your feedback...**we've been improving *73* for the past months with more articles, easier reading type, etc. And honestly, we *need* your feedback (in detail) if you have any critique either for or against the subtle changes that we've made. We know we can't please everyone every time, but if you tell us what you want *73* to be, we'll at least try to head in the direction for further "improvements" that might be most appealing to you. Thanks.

NEVER SAY DIE

Continued from page 55

64-page book of 60 of my editorial segments which hadn't yet been in *73*.

All this got started with my first RTTY newsletter, 45 years ago. I was inspired by the John Campbell W2ZGU editorials in *Analog*. Well, it used to be *Astounding Stories*. Unlike any other magazine I've seen, John wrote long editorials about anything he thought the readers might find interesting. I started reading his editorials around 1938, when I got interested in science fiction. Unfortunately John smoked, so he died relatively young, robbing the world of a lot of entertainment. If you find yourself near an antiquarian book store, look for a 1966 Doubleday book of John's collected editorials. You'll treasure it.

As John wrote in his March 1965 editorial, "Editorially I shall continue to try to investigate the nature of the stuffing in any suspiciously bulging shirts around. My business is directly concerned with the progress and achievement of the human race; any orthodoxy that tends to sidetrack or otherwise impede progress is interfering with my business, and I'll do what I can to sabotage them." You could do worse than follow in his footsteps. Just because a lot of people believe something doesn't make it true. In fact, the likelihood is that it isn't true.

Are you still just sitting there? Get cracking! Let's see what you can do. But please be sure to do your homework before you write. Know what you are writing about.

Placebos

Back when cortisone first became available an arthritis patient pleaded with her doctor to let her have some. The doctor said that, well, cortisone was hard to get, but he had a new remedy that was supposed to be almost as good. For four weeks he gave her cortisone shots, telling her it was the new remedy. She showed no improvement. Then he said that the cortisone had finally come in and showed her the ampule. But he switched to a sterile saline solution for her

Continued on page 77

In Search of Higher Power

... and a safe connection for it.

Robert W. Vreeland W6YBT
45 Maywood Dr.
San Francisco CA 94127

Recently I saw an ad for a neat little 500 watt PEP mobile amplifier. It looked like a great way to get in some really high powered 75 meter mobile. Then I thought about how I would get power from the car battery to the amplifier, which required 13.8 volts at 80 amps peak. Supposing that the total resistance of the cables plus contact resistance was 0.02 ohms (not an unreasonable assumption), the peak IR drop would then be 80 times 0.02, or 1.6 volts. This would leave 13.8 minus 1.6, or 12.2 volts to power the amplifier; not good, but I could probably live with it.

Next I thought about the I^2R power lost in the cables and connections. It would be 80^2 times 0.02, or 128 watts! This might even start a fire. The problem is not with the amplifier, but rather with the method of connecting it to power. Obviously, high power 12 volt equipment requires special care in installation.

The options

What about a solid-state 120 volt powered linear for home use? There are several on the market, but they are all very expensive. One in particular caught my eye. It is rated at a full kilowatt output at 100 percent duty. What a beautiful unit! In order to achieve such high output, they used 48 separate MOSFETs. No wonder it costs well over $4,000.

There are a number of vacuum tube linears in the under-$2,000 price class. What do the vacuum tube people know that the solid-state manufacturers may not? More than 50 years ago they learned that the way to increase output is to raise the voltage, not the current. High current means high component losses.

MOSFETs

Probably the first really good RF power transistors were made by the Amperex division of Phillips. With a 28 volt supply, their BLX14 put out 50 watts PEP. The BLX15 put out an astounding 150 watts using a 50 volt power source.

Most manufacturers saw more money in the 12 volt mobile market and neglected the high voltage high efficiency field, but at least one manufacturer has introduced a line of high power RF MOSFETs designed for use with a 50 volt supply. This is definitely a step in the right direction. The catch is that inside what looks like a single transistor there is a whole bunch of separate MOSFETs, each with its own gate and source connecting wires—a very expensive type of construction.

"Most manufacturers saw more money in the 12 volt mobile market and neglected the high voltage high efficiency field."

What about really high voltage MOSFETs? There are 600 and even 800 volt models available. They are used in low frequency switching applications. The problem is that they are generally not designed for RF use. They usually have very high input and output capacitances and a slow rise time. Well, not always. A company called Supertex (1235 Bordeaux Drive, Sunnyvale, CA 94089) has developed a proprietary process whereby they can reduce the capacitances and the rise time. Although they are not in the really high powered transistor business, they have a couple of 600 volt MOSFETs that offer exciting possibilities. These are the VN0360N1 and the VN0660N5. I have used the VN0360N1 in an amplifier for 80, 40, and 20 meters[1]. For improved performance on 20 meters, I used the VN0660N5. It is a somewhat lower powered device with a better rise time and lower capacitances.

One nice thing about 600 volt MOSFETs is that they are high impedance devices and are therefore suitable for use in tuned amplifiers. Another advantage is that they can be powered by the rectified and filtered 120 volt line without the need for a power transformer. My 20 meter amplifier uses a pair of VN0660N5s in a tuned push-pull circuit[2,3]. It was designed to run AC-DC style on the 120 volt power line. At 27 watts output, it runs at 45 percent efficiency.

Actually, my design was quite conservative. A pair of VN0660N5s could handle substantially more power. They are designed to dissipate 45 watts each at 25°C. The rated DC drain current is three-quarters of an amp. Another advantage is their price. At about $2.25 each, you could afford to use multiple transistors for high power.

Considering the length of time that transistors have been around, it is sad that progress in the RF power field has been so slow. Perhaps it is time for hams to take the lead again. So get out your calculator and soldering iron and go to work!

References:

1. Vreeland, R.W., W6YBT, "Notes on a Lightweight Portable CW Transmitter with a Transformerless Power Supply," *QEX*, June 1988, pp. 11-13.

2. Vreeland, R.W., W6YBT, "More Gadgets for your MFJ-9020," *73*, October 1993, pp. 10-12.

3. Vreeland, R.W., W6YBT, Transformerless Amplifier," *73*, August 1995, pp. 48-54.

Antenna? What Antenna?

A stealth antenna farm for a small lot.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30, c/o Defendini
Salinas PR 00751-0030

Is an efficient antenna farm possible on a small lot? Yes, if you are willing to confine your operation to the seven ham bands from 40 through 10 meters, and are also willing to tweak an antenna tuner, which may be automatic or manually operated. With the new sunspot cycle just now beginning, these are the bands where the DX will be, where it will be easier to earn WAS, and where there will be many opportunities for casual rag-chewing.

But is it *really* a stealth installation that the neighbors won't notice? And how about restrictions against even TV antennas? How can this be possible?

Yes, it can be made "invisible" to neighbors, inspectors and casual passersby, even though it's right in view all the time. First I'll show you how to build it, then I'll show you some ways to completely fool anyone looking for an antenna. In fact, even another ham who did not read this article would never guess you had an efficient antenna farm while he was looking right at it. Now, that is about as stealthy as you can get—and still work the whole world.

The antenna farm

The antenna farm described here requires only three dipoles to cover all seven ham bands efficiently. All are slightly shorter than full-sized dipoles, but there are no traps—nothing fancy, just wire dipoles. They can be installed and fed separately, although this could take them out of the stealth category. They can also be installed horizontally and fed in parallel with a single feedline. I don't recommend either of these options; it is difficult to hide antennas which *look* like antennas even to a non-technical person.

I recommend installing the three dipoles as inverted vees using a common high support at the apex, which can be a mast, pole, tree, or anything else which is high enough. Also, I recommend feeding all three dipoles in parallel with a single feedline. Best of all, the recommended dipole lengths are all somewhat shorter than full half-waves and, while not resonant in any band, are easily and efficiently matched with any antenna tuner because all dipoles are close to the adjacent bands they are designed to cover.

"Your stealth installation can be made 'invisible' to neighbors, inspectors and casual passersby, even though it is right in view all the time."

What you will need

115 feet of antenna wire is sufficient to make all three dipoles, with plenty of wire left to make connections to the insulators. The center frequency of each dipole was carefully chosen so it will cover two or three adjacent bands, as listed in **Table 1.**

Feeders

I strongly recommend using 300- or 450-ohm open-wire feedline instead of coax. Because these dipoles are not resonant in any ham band covered there will be varying amounts of reactance at the center of each dipole. Feeding a reactive load will cause standing waves on the feedline, and power will be reflected.

This reflected power is subject to the same line losses as the forward power. Once it reflects back to the transmitter it is again reflected up the line to the antenna, where most of it is radiated and a small portion is reflected back once again to the transmitter. If coax feeders were used the I^2R losses would be much greater, and more power would be consumed in the coax on this back-and-forth trip. This situation occurs even with a 1:1 match at the antenna tuner, since the tuner is only tuning the rig to the line, not the line to the antenna itself. In other

Bands Covered	Dipole Overall Length	Length, Each Half
40 - 30 m	54 ft. 6 in.	27 ft. 3 in.
20 - 17 - 15 m	26 ft. 4 in.	13 ft. 2 in.
12 - 10 m	17 ft. 6 in.	8 ft. 9 in.

Table 1. Center frequency of each dipole was carefully chosen so it will cover two or three adjacent bands.

words, standing waves will occur on the line regardless of what type of antenna tuner is used.

Although similar standing waves and reflected power will occur on open wire feeders, the line loss is much less as the I^2R losses are so low as to be almost inconsequential. Remember that reflected power is always returned back to the antenna, *minus I^2R losses*, and re-radiated, *minus the power reflected* due to the line/antenna mismatch. This means that reflected power is not "lost" power—it is only lost when using a high loss feedline like coax, rather than the low loss ladder line.

Installation

Because every ham knows how to erect a dipole, either horizontally or as an inverted vee, and will do so if separately installed and fed dipoles are desired, I will describe only an easily-hidden installation with all dipoles erected as inverted vees and all using the same single support and fed in parallel with open-wire feeders. See **Fig. 1**, which shows the completed installation as viewed from directly above the central support.

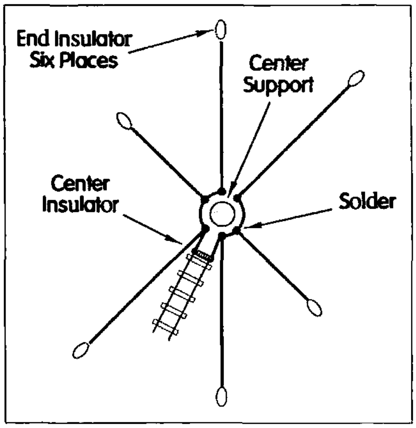


Fig. 1. Bird's-eye view of the triple-dipole antenna installation.

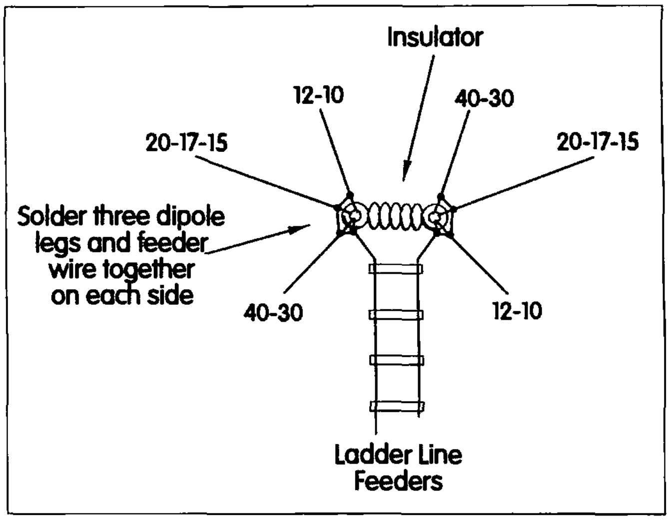


Fig. 2. Center insulator detail.

Seven insulators will be required: one at the common feed point, and one at each end of the three dipoles. Black braided Dacron® line about 3/16" in diameter should be used between each end insulator and its support point. The supports can be stakes driven into the ground, a hook on the side of a house or garage, a fence post, a tree—whatever is handy.

Although the 60° spacing shown in the bird's-eye view of the antenna installation is ideal, it is not a law of physics. Just space the halves of the antennas the best you can in the space available. The 60° spacing provides the least possible interaction between the dipole in use and the remaining two.

As the ends of the antennas are brought downward to tie off the ends to form inverted vees, do your best to have an included angle at the apex of each dipole of between 90° and 110°. Again, if space requires a somewhat greater or lesser apex angle, do the best you can.

Be certain the ends of the antenna wires are not less than six feet, and preferably somewhat higher, above ground. This keeps anyone from coming in contact with RF on the ends of the antenna.

Make sure the halves of each half-dipole are connected together at the feed-point insulator (see **Fig. 2**).

Tuning up

Your antenna tuner may or may not include a 4:1 unbalanced-to-balanced balun to match the unbalanced tuner output to the balanced feeders. If it does not, and all or most automatic

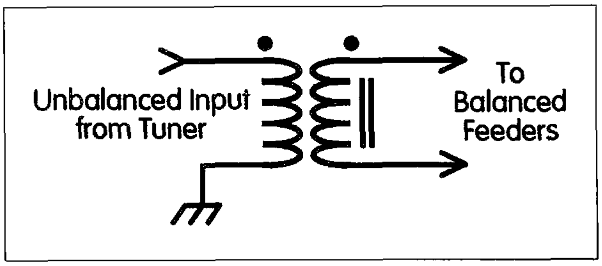


Fig. 3. Unbalanced-to-balanced 1:1 balun.

antenna tuners do not, you should build a balun to feed your antenna farm. Because the resistive component of the feed-point impedance on all bands is not too high, I suggest building an unbalanced-to-balanced 1:1 balun.

Caution: Be sure to use a core large enough for the level of RF power your transmitter produces. This is extremely important!

Fig. 3 illustrates the winding of a recommended 1:1 balun. It is bifilar-wound with enamel-covered copper wire of a size appropriate to your power output. For high power it is a good idea to cover the toroid core with a couple layers of glass or Teflon® tape before adding the winding.

Use a ferrite toroid, No. 43 mix. Calculate the number of turns necessary, using the formula below, with a required inductance of 0.075 mH (75 µH). The AL values differ for each size core and type of mix. Cores and a catalog sheet giving AL values and other information are available from Amidon Associates, Box 258867, Santa Ana CA 92799.

$$Turns = 10^3 \sqrt{\frac{mH}{AL}}$$

Another source of a complete line of toroids is Palomar Engineers, Box 455, Escondito CA 92025.

Hiding in plain sight

Depending upon many things, including the sensibilities of nearby neighbors and/or homeowners' association restrictions, you may find it necessary to camouflage your antenna farm without compromising the efficiency of its radiation. One of the best ways to camouflage the mast or pole supporting the feed point of your antennas is simply to place a birdhouse on top. Thus, your antenna mount has disappeared, while remaining in full view.

The antenna wires themselves escape notice, masquerading as guys stabilizing your lofty birdhouse. The end insulators, if they are white porcelain or glass, can be sprayed with black enamel. When the enamel is dry, rub a thin coat of silicone grease over the outer surface of each insulator to preclude any bridging of the insulators by rain. Dow Corning DC-3 or DC-4, or any product labeled "heat-sink compound" which does not contain white zinc oxide, are all good silicone greases.

Now that only *you* can see your antenna farm, the problem of bringing open-wire feeders from just below your birdhouse to the shack is more difficult. You might get away with explaining that the ladder line is actually a ladder for the use of birds with crippled wings. Don't take the easy way out, it won't be that difficult.

Parts List

- 115 feet of antenna wire
- 1 center insulator (feedpoint)
- 6 end insulators
- Black braided Dacron® rope, 3/16" diameter
- 1 unbalanced to balanced 1:1 balun (see text)

Bring the ladder line vertically down the birdhouse pole, stapling it occasionally through the insulation, or use hot glue. Paint the line the same color as the pole, at least as high as you can reach standing on a kitchen chair. Adults will never notice it, because few adults pay any attention to anything much above eye level.

The ladder line now will probably have to be routed through a length of PVC pipe from the pole to the shack wall, but it's not a good idea to have your feeders close to the ground. The pipe should be more than head-height above the ground and be painted to match the general area, perhaps even mottled to break up its lines.

The pipe containing the feeders, if supported by a few uprights which have vines planted around them, will turn this part of your feedline into a growing frame for grapes, flowering vines, pole beans etc. It might also be a good idea to temporarily wind some plastic vines around the uprights and feeder pipe as immediate camouflage.

Plastic vines can also be wound through ladder line and the feeders taken directly from the pole into a second-floor shack, though this might invite comment.

If you want to find out just how stealthy you have made your antenna farm, invite a ham who has not read this article to your home and "cry on his shoulder" a bit about the antenna restrictions and not being able to put up a decent antenna and see what suggestions he has to offer. Take him into the yard and ask for ideas. He probably will suggest a vertical attached to the side of the birdhouse pole. Then take him into the shack, turn the rig on, and let him be amazed at what he can hear as you have a QSO or two. Then, just to be friendly, tell him who told you how to do it.

Because each stealth antenna farm will be different, use your imagination. I've offered a few hints here, but you'll probably have even better ideas. And maybe you'll write about 'em.

Hentenna Footnotes

Using an EZNEC model to build a sample.

Thomas M. Hart AD1B
54 Hermaine Ave.
Dedham MA 02026

I like antennas and antenna articles. Recently, I have discovered the joys of modeling antenna designs on the computer with the EZNEC program (available from Roy Lewallen W7EL, P.O. Box 6658, Beaverton OR 97007; phone 503-646-2885, FAX 503-671-9046, E-mail w7el@teleport.com), and only building samples if the results look promising.

73 printed an interesting article by KAØDAQ in the April 1996 issue, titled "The Hentenna." For the first time, I found a complete set of formulas in print that helped in the design work.

In order to learn more about the Hentenna, I reviewed my own antenna references, ran a model on EZNEC, and built a sample for the FM broadcast band.

Hentenna Computations

MHz	1/2 WL	1/6 WL	Total Wire	Feed Point	
146.0	3.4	1.1	11.5	0.8	Feet
	41.3	13.8	137.7	9.6	Inches
90.9	5.5	1.8	18.4	1.3	Feet
	66.3	22.1	221.1	15.5	Inches
50.1	10.0	3.3	33.4	2.3	Feet
	120.4	40.1	401.2	28.1	Inches
29.5	17.0	5.7	56.8	4.0	Feet
	204.4	68.1	681.4	47.8	Inches
28.4	17.7	5.9	59.0	4.1	Feet
	212.3	70.8	707.7	49.6	Inches
21.3	23.6	7.9	78.6	5.5	Feet
	283.1	94.4	943.7	66.1	Inches
14.2	35.4	11.8	118.0	8.3	Feet
	424.6	141.5	1,415.5	99.2	Inches
7.2	69.8	23.3	232.6	16.3	Feet
	837.5	279.2	2,791.7	195.7	Inches
3.6	139.6	46.5	465.3	32.6	Feet
	1,675.0	558.3	5,583.3	391.4	Inches
1.8	276.1	92.0	920.3	64.5	Feet
	3,313.2	1,104.4	11,044.0	774.1	Inches

Evolution of the Hentenna

A book, now long out of print, *Radio Amateur's VHF Manual* (©1972, ARRL), describes the "Skeleton" or "Slot" antenna based on designs by B. Sykes G2HCG. The illustration shows the process that changed two horizontal half-wave dipoles into the final rectangular Hentenna design. The antenna was popular at the time of publication and a commercial model was marketed by J-Beams Ltd. The antenna is characterized as horizontally polarized, with vertical sections that act as wide-spaced transmission lines.

Etymology of "Hentenna"

"Hen" comes from the Japanese word for "interesting" or "unusual." In an article titled "Let's Make the 'Hentenna'" (*QST*, February 1982), Koji Sugihara JJ1UMS stated that the design was very popular on 6 meters (about 10% of the installed base). Horizontally polarized, the antenna was very forgiving about dimensions; a 5-10% variance from design specifications had little effect. The antenna could be fed with either 50 or 72 ohm coax, directly or with a balun. The feed point was a Y-shaped wire that was moved up and down to determine best match before final attachment.

Dimensions

Table 1 shows the lengths of the sides, as well as feed point location, based on the experiments by KAØDAQ. Clearly, the antenna is best suited to 10 meters and above. It would be possible to try

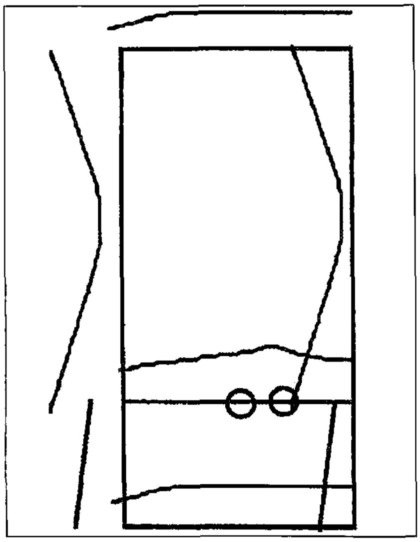


Fig. 1. Currents on the antenna during operation.

one on 15 and 20 meters, but the structure starts growing large here. Hentennas on 40 through 160 meters are well out of the ordinary person's reach. I had no problem constructing and using a sample on 90.9 MHz, the local National Public Radio Station, WBUR in Boston. It works!

The 10 meter report

Bill Orr W6SAI included an illustration and discussion of the Hentenna in his monthly column in *Ham Radio* magazine, May 1989. He discussed a letter from JE1DEN which contained information on using the design on the 10 meter band in Japan.

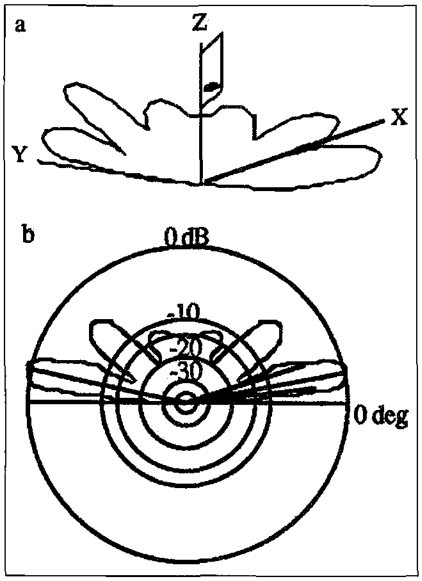


Fig. 2. EZNEC elevation plot, perpendicular to antenna plane.

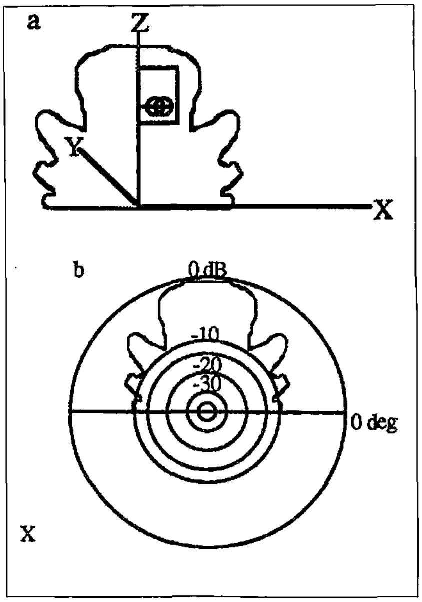


Fig. 3. EZNEC elevation plot in the plane of the Hentenna.

EZNEC report

Fig. 1 shows the currents on the antenna during operation. Next, elevation plots were prepared to show that the strongest radiation is perpendicular to the plane of the antenna. The takeoff angle is 11 degrees in the sample, favoring distance work. The elevation pattern in the plane of the antenna is, as expected, attenuated and provides a high takeoff angle of 81 degrees.

> ***"The Hentenna is a very interesting, often overlooked, design that can be used on HF and VHF installations."***

Switching to the azimuth plot, we find a very pronounced figure-eight pattern. This has been reported in the literature and supports the elevation plot data. The Hentenna is strongly directional and can be used with parasitic elements.

Polarity considerations

The Hentenna is horizontally polarized. Does this matter? The answer is "maybe." If you operate on the HF bands and depend on the ionosphere, the answer is probably an unqualified "no." Refer to the *ARRL Antenna Book* (©1994, ARRL). Here, we find that in the range from 3 to 30 MHz, skywave transmissions change their polarizations.

Antennas at either end of the connection don't need to have the same polarization.

For short-path communications, VHF FM work for example, polarization may be quite important. Cross polarization can result in 20 dB losses in cases where different methods are in use at the transmitter and receiver.

Conclusions

The Hentenna is a very interesting, often overlooked, design that can be used on HF and VHF installations. The literature contains references to installations on 10, 6 and 2 meters. The structure is simple and rugged when properly assembled. The horizontal polarization may be a concern in VHF use, especially on repeater work. This design is one that should not be overlooked when planning additions to the antenna farm, or in my case, antenna garden (I have too little space to build a farm!).

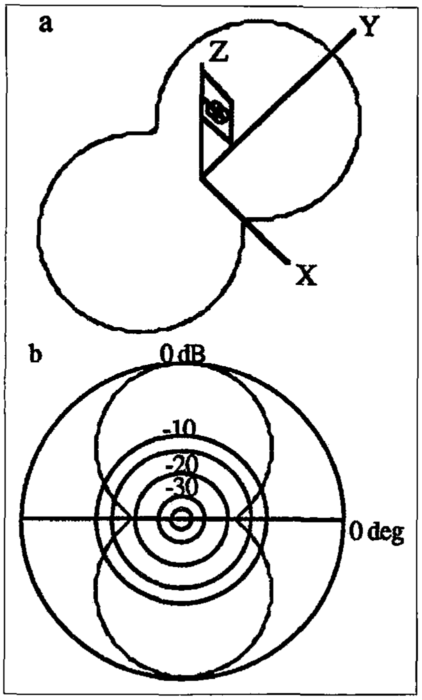


Fig. 4. EZNEC azimuth plot of the Hentenna.

NEVER SAY DIE

Continued from page 69

shots and she showed an immediate and dramatic improvement.

Though the medical literature has thousands of similar stories and doctors are quite familiar with this response, which they call the placebo effect, what they haven't done is find out how and why it works so they can then harness its power to help cure people.

I've seen medical reports saying that the placebo effect can work in up to 80% of all illnesses. But no matter the percentage, here is a way which could help cure a wide range of illnesses that the medical industry is refusing to research and develop. Why? Simple, there isn't any money in selling placebo based cures.

Back when I was a professional psychotherapist I found that every illness had a psychological trigger. By de-activating this trigger the illness would go away. And the de-activating procedure was fairly simple. At the time the medical industry ridiculed the whole idea. In the intervening years doctors have come to admit the importance of psychological components in illnesses, but I defy you to find one doctor anywhere in the world who is making use of this knowledge.

Twenty years ago I suggested in an editorial that one excellent application for personal computers would be to use them in doctors' offices and hospitals to uncover the psychological trigger for illnesses. The procedure is so simple that even a desktop computer, operated by the patient, could be programmed to find these triggers for doctors. There would, I suspect, be a pretty good market for such a computerized diagnosis system.

Then I'd have to write a handbook for doctors on how to de-activate the psychological triggers, since I suspect I'm one of the few people left who know how to do this.

What is Truth?

If I say that I believe that extraterrestrials are and have been among us for thousands of years, is your reaction that poor old Wayne is off his rocker? Or do you agree? And if you think I'm off my rocker, are you at least willing to look at the evidence that convinced me?

Okay, how about telepathy, auras, spoonbending, psychokinesis? These, too, are subjects that are off-limits for scientific investigation. Not only won't they be funded, ridicule and humiliation await the brave and inquiring.

Now let me be specific. Let's take Uri Geller, for instance. Was he just a stage magician or was he really a psychic? Unless you've done some serious research you probably don't know that Geller performed for scientists under the most carefully controlled laboratory conditions. He has been videotaped while being carefully watched by both professional conjurers and scientists, using no materials provided by him or that he even had prior access to, remotely affecting scientific instruments, even producing objects out of thin air, and locating hidden objects with no errors.

Geller submitted to endless exhaustively controlled experiments at several colleges. For instance, a dozen aluminum film cans would be put on a table. Some had water in

Continued on page 78

NEVER SAY DIE
Continued from page 77

them, some steel balls, and some sugar cubes. Geller did not touch the cans, but was able to identify the contents in all 12 correctly. The odds were over a million to one. Geller was able to make Geiger counters click, and other scientific instruments give weird readings.

Yes, I agree, I'm off my rocker. But that's because I haven't time to sit around rocking when I prefer rocking the boat. I've a nice rocker—a gift from an appreciative college president for my consulting work for him and the deans. But how can I spend time sitting around rocking in my old age when I feel I should be writing about the anomalies that the scientific establishment is not just ignoring, but is actively trying to prevent being investigated?

Like, did you know that plants somehow communicate via UV? The research results are amazing, but the odds are that you've never seen them published. Ditto the work of Rife, Naessens, Reich, Ott, Backster, Tesla, Rawles & Davis, and a bunch of other martyred scientific pioneers. Books about many of 'em are on my $5 list of books you're crazy if you don't read. On trips, my suitcases are more loaded down with books I'm reading than clothes. Or are you like the average American schoolteacher, who reads one book a year (usually fiction)? I read two or three non-fiction books a week. Sure, some are a waste of time, despite high recommendations from readers, but others go from good to superb, with a few making it when I update my book list.

Perhaps you can understand why I see so many pioneering opportunities for anyone with the guts to oppose the scientific mainstream.

Day Care

The election of state senator Jeanne Shaheen to governor of New Hampshire got me to thinking. I worked with Jeanne on the Educational Subcommittee of the New Hampshire Economic Development Commission, so I got to know her pretty well.

Jeanne had a fixation on the need for New Hampshire schools to be legislatively forced to include kindergarten for five-year-olds. I agree that youngsters should be given every opportunity to learn during their early years, but I'm just not a fan of having the government force everyone to do what a legislature has decided is best.

For that matter, I am most critical of the whole "day care" concept. I grant that there may be some day care centers that provide children with the opportunities to learn a wide variety of things. However, I suspect that most of them operate like the ones I've seen where the children are started early being taught regimentation, and their exposure to new ideas and experiences are limited to what Sesame Street and Mr. Rogers provide.

Here is a time, when kids are two to five years old, when around 90% or so of their lifetime character is being formed. This is a time when they should be provided with the tools and encouragement to learn and experiment.

This is the best time to teach children several languages. This is when they should be helped to experiment with drawing, clay, painting, playing musical instruments, exploring nature, and be taught any skills that may interest them—like juggling, gymnastics, playing games, learning to read, building their vocabularies, skating, skiing, swimming, and so on. This is the time when individual interests should be encouraged rather than group conformity. Between genes and early nurture, everyone is different. But it takes a teacher/salesman to enhance the positives and bring out the uniqueness of each child without stifling their curiosity and enthusiasm.

Early animal trainers used punishment as their main method of teaching. Then it was found that far faster and better results were obtained using kindness and reason. This concept has not yet caught on with many teachers and parents. It does require that the teacher be able to outthink the animal (or child) and devise a way to convince the animal that it wants to do what the teacher is encouraging. This results in a happy, cooperative animal. And child.

Perhaps if we change the name of day care centers to early learning centers that would help. Ditto children's garden, a.k.a. kindergarten, which should merely be an extension of the early educational and development process. Given the opportunity, encouragement and the tools, many kids will be able to enter the first grade already accomplished in reading, writing, dancing, acrobatics, playing one or more instruments, able to speak several languages accent-free, be good swimmers, and have already developed several other skills. To do other than this is, to some degree, putting children in straightjackets mentally and developmentally. And remember, that once the window of opportunity for children to learn certain skills has passed, it is a lost opportunity. For instance, never again will children be able to learn many languages as easily. I suspect that musical and dancing skills are the same.

Portable Classrooms

I've proposed that state school systems encourage (and fund) their schools to build portable laboratories into trailers so the facility can be shared by a number of schools. This would make it so that chemistry, woodworking, metalworking, electronics, computer, photography, video production, audio recording, music appreciation, cooking, and other such expensive equipment systems could be shared by several schools, thus

providing a greater learning experience at a lower cost per student.

I'll bet a good deal of corporate funding could be made available to help build these mobile labs.

For the younger kids this would make a way to bring exploratoriums to them, to provide them access to more expensive musical instruments such as pianos, electronic instruments, and recording facilities.

But how can we bring about the needed change? If you do nothing, nothing will change. If you start pushing for change most people will fight and ridicule you.

Are you a leader or a follower? Our present day care and school system inculcates us early on to be followers. Don't rock the boat. The nail that sticks out gets hammered down. If it ain't broke, don't fix it. Ya-ta-ta, ya-ta-ta. Maybe, if you'll help fix our educational system, we'll have more leaders and fewer followers. Boy, will that screw things up! Ha!

Arrested!

Greg Godsey KF4BDY, a 16-year-old ham from Paulette Court, Kentucky, was arrested while demonstrating the severe weather Skywarn system to a group of people. He was charged with the possession of a police scanner, impersonating a public servant and disorderly conduct. The police confiscated his Radio Shack HTX-202 2m HT.

The HT was later returned when the police found that it was a legitimate piece of ham radio equipment which could not be used to eavesdrop on their communications. But for some reason they'd taken it apart, so it had to be sent back to Radio Shack to be serviced.

And what about the impersonating a public servant deal? Well, Greg had an Amateur Radio Emergency Service ID. But the police and the court refused to accept that ID, so as far as they are concerned a credentialed Amateur Radio Service volunteer *is* impersonating a public servant and that constitutes an act of disorderly conduct.

Thanks Chicago FM Club *Squelch Tale* for that gem. Remember, the police are your friends and judges are ex-lawyers. However, if you have an ARES card, it can get you arrested. You go to jail and the court collects the $200.

Nondisclosure Agreement

How'd you like to make a few million bucks? Well, I have an idea for a simple electronic product that'll be easy to make and should sell by the carloads. It could almost revolutionize an industry. We need a manufacturer and a hundred or so sales and service reps.

Now, before I disclose the details of my idea I want it understood that the reading of this constitutes a legal binding contract between you and Wayne Green that you will (a) not disclose this idea to anyone else, and (b) if you decide to get involved in the manufacture or marketing of the products described that you will reserve a minimum of 2% of gross sales as a royalty for said Wayne Green.

That out of the way, here's the sneaky plan. The germ for this idea was spawned back around 1978 when Sherry and I had lunch with Ed Juge W5TOO at a Mexican restaurant in Ft. Worth.

I'd known Ed for many years. He'd advertised his Juge Electronics store in my magazine and we'd gotten to be friends. Cut to 1975 when I was taking the first issue of my brand-new *Byte* magazine around to drum up advertising. My first stop was with Sphere Computers in Salt Lake City. Then down to Albuquerque to visit Ed Roberts at MITS. From there I stopped at Ft. Worth and dropped off some copies of the magazine with Ed Juge, explaining that I felt that the personal computer field was going to eventually be a huge new business that would eventually be larger than the automobile industry.

Ed bought an Altair 8800 from MITS (the first microcomputer) and was hooked. The ARRL's so-called "incentive licensing" proposal had so gutted the ham business that Ed was fed up and was looking for something new to do. It was at this time that Radio Shack decided to get into the personal computer business. That's a whole story in itself—one that needs to be told. Anyway, since Ed was right there in Ft. Worth, and already had some experience with microcomputers, he joined Radio Shack to help them market their TRS-80 computer. It was a great little computer and, with the help of several thousand stores to sell it, it quickly grabbed the lion's share of the market.

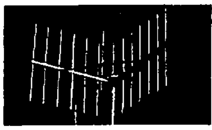
Getting back to that Mexican lunch. This restaurant had a little flag on each table for us to raise when we were ready for more hot *sopaipillas*. Great idea. (Then there was a restaurant in Manchester (NH) that had a light you could switch on to call the waiter. Also a good idea.)

You have the same problems I have. You have to wait for a menu. Then you have to wait for the waiter to notice you're ready to order. When you run short of water or something, getting the attention of the waiter is difficult. The worst is getting the check. At that time the waiter totally disappears as your frustration mounts. It helps you understand why these people are called waiters. They make you wait. And wait. It's no wonder fast food has gotten so popular.

Okay, Gadgeteers

What we need is a beeper system, with one unit attached to your waiter to show the number of the table wanting service, and a unit on your table to call the waiter. Whether it is infra-red or microwave is up to you. It wants to be simple, as inexpensive as possible, legal, fairly foolproof, and not require much service. If there is such a product I haven't seen it at any electronic shows, nor have I heard of any restaurants using one.

Continued on page 81



The Quest for the Ideal QTH

A New Jersey paradise for this ham.

Bert Simon K2FZ
2110 NW 45th Avenue
Coconut Creek FL 33066

At one time my goal was to be the "buzzard on the highest perch." I sought the ideal radio location—and eventually found it, lived on it, and enjoyed every moment of being there.

I laid claim to having the highest permanent resident ham location in New Jersey. The highest point in New Jersey is at an area called High Point, and if my memory serves me right it was in excess of 1,800 feet above sea level. The location I eventually settled for was at 1,240 feet above sea level and was approximately 300 feet above average terrain. A 60-foot tower would put my beam antennas more than 1,300 feet above sea level. Although I worked other stations in New Jersey that were higher, they were Field Day setups—with High Point, of course, being one of the favorites.

It doesn't take a rocket scientist to realize that when it comes to strong ground wave signals, the higher the ground and the clearer the shot means the stronger the signal. And so the search went on to find that elusive higher ground which would lead to a ham paradise, the ideal radio location.

There were other factors to consider. Was the QTH readily accessible without investing thousands of dollars to build a road? Was electrical power available or would I be required to spend additional kilobucks to put in power lines and/or an independent generator? Could I get in and out when the snowstorms arrived? Was it far enough away from the very high voltage power lines which could radiate enough 60-cycle harmonics to bounce signals off Saturn? Were there any restrictions (or possibility of) involving townships or neighbors who might not appreciate the wonderments of an antenna farm? At one time I was approached by some township officials who voiced the opinion that "They weren't sure whether they wanted radio towers in their township." I informed them that I had permission from the FCC and the FAA to construct the towers and that was all I needed, but that was then and this is now. I would recommend further study and perhaps some legal advice. The other factor, carrying perhaps the most significance, was the ability to convince a spouse that "this is the place to live."

"The band was dead with respect to skip, but on many occasions ZSs would break in just to let me know that I was the only stateside station being heard."

Choosing the site

I started on my ham crusade by obtaining geodetic and survey maps for the entire state, and then spent a great deal of time studying them and visiting many proposed locations. Was the subject QTH far enough from heavily traveled highways so as not to be subject to automobile ignition noise? Finding proposed locations was relatively easy but finding the ones that had land available and accessible was another problem. I recall many disappointments.

I made my choice and I'm happy to report that between 1959 and 1978 I had the greatest ham location that one could ask for—and one every ham should experience. There were certainly many higher locations available throughout the United States but were they within radio metropolitan range of an area such as New York City? Mine was, and that added so much joy to the ground-wave contacts, which had an approximate radius of 200 airline miles. The QTH I had chosen was about 40 miles northwest of Central Park, New York City; for those familiar with New Jersey, it was in Jefferson Township at the intersection of Morris, Passaic and Sussex counties. It was on the northwest ridge bordering the Oak Ridge Reservoir, which supplied water to the city of Newark. My five acres of property bordered on thousands of acres belonging to the City of Newark Watershed.

There were no restrictions on antennas. I could put up anything I wanted. I settled on a seven-element triband beam for 20 through 10 meters and antennas ranging from 11 elements on 6 to 20 elements on 2, not to mention full-size dipoles on 80 and 40 meters. Life was good!

Another desirable factor in a great QTH was to have a low-noise location, radio-wise. This was borne out by the constant "whistlers" (part of an ionosphere phenomenon) I would detect in the 20 to 30 MHz range. I would pick them up slightly higher than 30 MHz and observe on a panalyzer as they waddled down in frequency (it really looked like waddling) until they diminished somewhere about 20 MHz after sort of "FMing" themselves to death.

Some highlights

I can recall one winter snowstorm when all travel came to a halt. I heard some QRN on the 15 meter band that sounded like noise being generated from some type of an electrical appliance. I left the door of the radio shack open, stepped out into the snowbound road and looked down into the valley where I could see a section of Route 23 in Stockholm, New Jersey, which was approximately three miles away. I heard the noise in the receiver and simultaneously spotted a puff of smoke coming from a snowplow. This was repeated several times until I realized that the snowplow was the source of the noise and since it was diesel-operated, what I was hearing was not ignition noise, it was alternator noise—three miles away. Early morning differences in noise background could be detected depending upon the pointing of the antenna with respect to the sun. I can recall observing some weird noise which sounded like a mishmash of several signals when the antenna was pointed in a certain direction, which happened to be towards the abandoned Edison mines, about eight miles away. I never did find out what caused that interference; the signals weren't that strong and besides, I couldn't find anyone else who could hear it to confirm its presence.

"I could put up anything I wanted—life was good!"

I remember, with delight, many evening ground-wave QSOs with New York City/Long Island hams which put my antenna in the direction of South Africa. The band was dead with respect to skip, but on many occasions ZSs would break in just to let me know that I was the only stateside station being heard. I guess having a Henry 2K4 and six elements on 15 didn't hurt. On many occasions I would work 15 meter ground-wave stations at a distance of approximately 200 miles and the ham on the other end would excuse himself so that he could work "other short skip stations."

So why did I give up this ham paradise? It was just time to do something else. I sold all my possessions, bought a sailboat and lived aboard while spending the next 15 years in the sunny Caribbean between Puerto Rico and the Virgin Islands.

Within the past year I had occasion to be within five miles of my old QTH and couldn't resist visiting. My old ham shack was now in use as a garage—to coin a cliché, you can't go home again. 73

NEVER SAY DIE

Continued from page 79

Step one is to design the transmitting and receiving units. Keep 'em simple. Sure, I'll be glad to publish your solution, if it looks promising. And yes, any manufacturers who decide to use it should pony up a 2% on gross sales royalty to you too.

Once something like this starts to catch on, every restaurant will have to invest in a system.

My preference would be to use infrared—like your TV remote control units. With a little power a table unit can cover a large area. A booster can be installed if needed to cover the kitchen.

Hey, do Sherry and I get some free meals out of this?

Selling Music

For that matter, you should be able to make a nice living selling audio systems to restaurants, complete with CD players and a set of appropriate ethnic music CDs. Mexican music for Mexican restaurants; Italian, Chinese, and so on. The sales and service in providing good music for a few hundred restaurants should keep you out of trouble. The next thing you know you'll be on your way to Mexico, portable digital recorder in hand. Or Greece. Or Japan. Oh, and don't forget that 2% for Wayne. On gross sales. 73

LETTERS

Continued from page 62

While waiting for one of their security people to drive me back to my apartment, the Colombian Navy captain and I were alone and he told me about an encounter one of their frigates had with a UFO one night while on patrol along the Colombian coast. Recently I had a Colombian AF colonel in one of my classes at DLIELC, so I asked him if he had ever been given a briefing in which he was told that we have been having extraterrestrial visitors. Looking at me directly, he responded, "Yes." Most Colombian AF officers apparently have not had such a briefing, only those working at the highest levels.

Continued on page 82

LETTERS

Continued from page 81

A couple of years ago I participated in a MUFON investigation of a family's encounter with a UFO that had hovered over their farmhouse near San Antonio, frightening them badly. There were three witnesses: a mother and two of her children. The 13-year-old daughter stayed outside looking at the craft the longest and experienced some physical symptoms (sunburn, fever, etc.). All felt heat and came down with colds shortly afterwards. The younger son will not go outside the house alone anymore and the daughter couldn't sleep at night for long afterwards. Other strange things occurred that evening and there is some suspicion that one or more family members were abducted. The UFO phenomenon is quite bizarre and I'm also puzzled, amused and frustrated by the strange human response. Why aren't more people eager to find answers to the questions being raised?

That's simple, Cliff: We believe what the government tells us. The government wouldn't lie to us. But then there are a few troublemakers like you and me. I personally know the government is still lying about Amelia Earhart, even after 60 years.

A few years ago I was called by a farmer to look at some crop circles in Francestown, NH. I talked with the woman who lived next to the farm and she told about a UFO that had hovered over her house for several minutes a few nights previously, scaring the heck out of her and her children. When her husband got back he ridiculed her and the kids. The next day he apologized when he reported that the staff at the Crotched Mountain Children's Rehabilitation Center a few miles away reported the same silent bright light hovering over their buildings that same evening, and then zooming away at an incredible clip.

Then there's a chap with the highest security clearance who is a consultant to President Clinton who called me a few days ago. He's had several contactee experiences himself and his son, in Annapolis, reports that they are teaching the upper class students that the ETs are already here. I do wish someone would teach these critters to talk instead of always using telepathy, and lend them some HTs so we could let them hear what a pileup sounds like... Wayne.

John Peters K1ER/KH6. You asked for a report on Dayton. Well, in brief, it stank. The WX used to be wet and cold, which was easy to handle with a waterproof jacket. This year the stupidity of the shift to May was demonstrated by pouring rain for several days before the HamVention, making it possible for the humidity to be unbearable on Friday and Saturday when the temperature was unbearably *hot*. The flea market seemed to be about 50% full, with many of the spaces purchased by people looking for a close-in parking space. Nothing in the flea market space but a parked vehicle. The flea market was *not* taken over by computers, it was taken over by completely useless junk—old lab equipment (junked by hospitals), old telephone equipment junked by some telephone company. Much less ham gear or computers than before. The tent area, normally known for the two or three inches of water running over your feet, was hot and humid, and contained basically the stuff that didn't sell at the local Radio Shack. The flea market was a bust. The inside displays were the same gang as usual. It would be hard to tell one year from another, except that it was *hot*.

You should have had your own forum in competition with those scheduled. Best example was the DX forum. Scheduled to start first thing in the morning with a set schedule of topics. So far so good. The first event was Bill K from the DXCC desk who was scheduled to talk for 30 minutes or so. He took five to say the card checking backlog is gone and all's well with the world. The DXAC chair then announced that there was really nothing controversial going on with the DXAC (probably the most blatant statement before the presidential lies started) and sat down. With no questions or arguments, and since the forum was then approximately 50 minutes ahead of schedule (the later speakers had not arrived), they

just adjourned! The speakers arrived to find an empty hall. The DX Dinner was not improved over prior years. But anyone who doesn't know that deserves bad food, bad acoustics and bad service. I was supposed to help open a hospitality suite 30 minutes before the scheduled end of the DX banquet, and at that appointed time the banquet food had not yet been served. I could discuss other events, but why bother? The only reliable high spot was the bar on the top floor above the DX dinner, which was as good as ever in spite of the hotel sale to the Holiday Inn chain and name change. Same friendly staff every year.

They should move the event back to April when the weather can at least be compensated for with clothing. Don't ask why any sane person would go from Hawaii to Ohio in May! I figured it was close enough to the International DX Convention in Visalia, so why not? Now I know why not. At least the museum at Wright Pat had a few new exhibits, and I saw a few hams I knew. I may go next year just for the Collins Collectors meeting and skip the rest. I figure Slick Willie is going to get us into a war in Korea again by continuing to weaken the military, and the troops will need phone patches home. I need more things for the MARS frequencies before it starts.

I had expected to hear you at Dayton; sorry you weren't there. If you want to lose weight, the food and heat will sweat off a few pounds. I'm not sure any magic is involved in living long. Just stay away from doctors and hospitals (that's where the pathogenic organisms are found!) and have DNA from great-great-grandma who lived to 104, grandparents to 98, and eat less.

Hmm, by publishing your letter I've probably guaranteed that I won't get invited to speak next year. C'est la vie. But, how about some positive letters? Some of you must have had a really good time! Speak up. However, with that humidity and temperature I can understand why the speakers didn't want to talk very long. The thought of around 50,000 pounds of ham fat in a closed steam room is challenging... Wayne.

Number 83 on your Feedback card

UPDATES

Resistance is futile?

If you look at **Fig. 1** of "Enhanced Automatic Voltage Controller" on page 43 of the January issue you'll see that we neglected to label one of the resistors. The resistor right next to R12 is R11.

Frank-ly speaking...

In Frank Brumbaugh's "Audio Filter Alignment Generator" from the December issue (page 42) there was a typo in **Fig. 1**. The **3** was accidentally labeled **9**.

In addition, Frank sent us a memo saying that there have been some problems with the 74LS90 chips: If the output from pin 11 of U2 does not divide by 5, you should take the output from pin 8 instead. 73

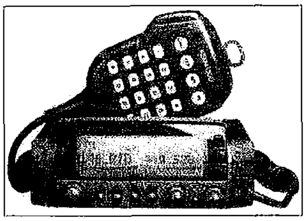
Bruce Muscolino W6TOY/3. Dayton Bombed? I think not! Seemed to me the crowd was pretty much on a par with last year. True, nothing like five years ago, but still a fun and worthwhile trip, and no rain!

One group of hams actually had a bumper year this year at Dayton—the QRPers. The story began in 1995. Traditionally, like many other special interest groups, the QRPers hold a separate meeting. Our meeting is sponsored by the QRP Amateur Radio Club International (QRP-ARCI) and is complete with a hospitality suite, vendors, radios to operate, and a place to sit and tell war stories to friends. QRP enthusiasts from around the world attend each year, with a large group coming from the G-QRP club.

QRP is thought by many to be the fastest growing segment of amateur radio today. Certainly there has been tremendous interest in low power operation as evidenced by regional and national club memberships in the thousands and an active Internet list with nearly 2,000 members. However, the "dumbing down" of ham radio over the last 25 years has led to many hams who have less than a solid working knowledge of the technology underlying their hobby.

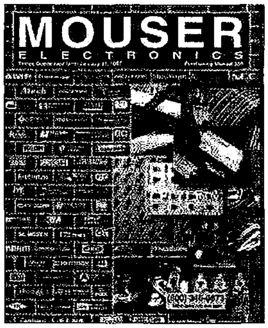
Continued on page 85

New Products



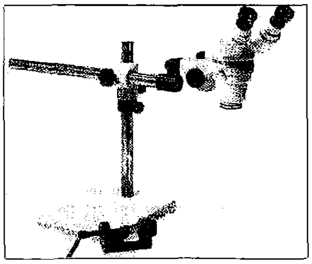
New, Cool, and Blue

Kenwood's new TM-V7A dual-band mobile is a sleek, slick baby with tons of features, including a large display and 280 memory channels. The front panel can be easily mounted anywhere in your vehicle and the optional voice synthesizer is handy as all get out for mobile operation. Transceiver guidance function shows you, step by step, how to perform some functions without the need for the manual. Visual Scan function allows you to look at band activity graphically, and there are more than a dozen other features. Check it out at your Kenwood dealer.



New Mouser Catalog

The latest electronics components catalog from Mouser is now available—332 pages of more than 68,000 products from today's leading electronics manufacturers, including new additions from Switchcraft, Cornell Dubilier, SGS Thomson, Xicon, and more. You'll find complete specification drawings, guaranteed prices, and same-day shipping on all in-stock products. Buyers, engineers, and just plain catalog dreamers will want to latch on to this one. For a free copy, call (800) 992-9943; E-mail catalog@mouser.com; web site http://www.mouser.com; FAX (817) 483-0931.

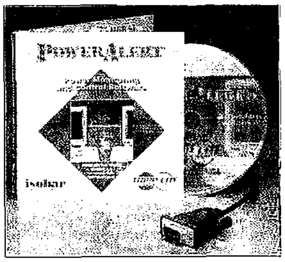


Booming Stereo

WASSCO introduces the new Stereoscopic Microscope on boomstand from Clearview Instruments. The boomstand is available with or without a clamp base; the arm extends to 16 inches around the base, and, with a 360° swing arc, it will go virtually anywhere around your work surface. The clamp base adds even more portability and flexibility.

The binocular head is at a comfortable 45° angle, so you can peer for long periods of time at those really delicate connections, and the image is unreversed, for uncomplicated manipulation of the item in view. Prisms maximize light transmission, and the parafocal zoom system keeps the image in constant focus—and it comes with a lifetime guarantee!

For a complete listing of Clearview Microscopes and advanced optical instruments, call 1-800-4WASSCO or visit the web site at www.wassco.com.



Cross-Platform Compatible

Tripp Lite announces Version 9.0 of PowerAlert Plus UPS power management software, which is the only software that has the capability to work with software sold by American Power Conversion (APC).

Version 9.0 will perform all functions of APC's PowerChute power monitoring software, including full system shutdown, system test and power failure simulation. Since Version 9.0 is fully compatible with all APC software features, users of current APC UPS systems are no longer dependent on using only APC products. Users can now take full advantage of Tripp Lite UPS systems without reconfiguring their server installations.

Version 9.0 is a no-cost option with Tripp Lite SmartPro UPS systems. It is also available separately for $89. For more information, contact Tripp Lite Customer Support at (312) 755-5401; FAX (312) 644-6505; E-mail: info%tripplite@mcimail.com; web site: http://tripplite.com.

Kepro Named Distributor

Kepro Circuit Systems, Inc., a St. Louis-based worldwide supplier of etched circuit board equipment and supplies, has been named one of the US distributors of KPR Liquid Photoresist products by Fry Metals. KPR is a high resolution liquid photoresist for fine line detailing of etched circuit boards. Designed specifically for undiluted use on copper, copper alloys, and anodized aluminum plates, KPR products are negative-acting photoresists for dip coating, flow coating, spray coating, and roller coating applications. Coatings can be air-dried or infrared oven-dried. Exposure is done with carbon-arc lamps, mercury-vapor lamps, pulsed-xenon lamps, and unfiltered ultraviolet fluorescent tubes. KPR products require specific developing solutions designed to be compatible with each photoresist. Since 1954 Kepro has provided state-of-the-art equipment and supplies for prototyping and short-run production of etched circuit boards, and Kepro products are available virtually anywhere in the world. For more information, contact Kepro Circuit Systems, Inc.; 630 Axminster Drive, Fenton MO 63026-2992. E-mail: kepro @worldnet.att.com, or call (800) 325-3878; Fax (314) 343-0668.

The Future 1 Is Now

It's smaller than a notebook, but so advanced it's set to revolutionize the telecommunications industry. The Future 1 Planar Satellite Antenna from *galaxis* can receive over 100 TV and radio stations, but its flat, compact design means it's much less obtrusive than traditional dishes. The totally weatherproof design ensures continual maximum reception for home and mobile installations, like RVs and boats. The Future 1 can also receive both analog and digital satellite stations, and it's just the first in a whole family of new antenna products from *galaxis* USA Ltd. See your antenna dealer.

New Free Catalog

MCM Electronics, for 20 years a leader in the distribution of consumer electronic repair parts and accessories, has released their new catalog. More than 6,000 items, including project accessories, semiconductors, connectors, test equipment, hundreds of original and generic TV/VCR parts are at your fingertips. New sections are included; computer software, gaming and amusement, printer parts among them.

Franchised lines offered for the first time in this catalog include Lexmark, ECG/Philips, and Sencore. Name brand offerings have been expanded to include Brax, Sovtek, and more.

Approved, in-stock orders received by 5 p.m. will be shipped the same day. For a free copy of this new catalog, write to MCM Electronics at 650 Congress Park Dr., Centerville OH 45459-4072, or call 1-800-543-4330.

AM Radio Log

The National Radio Club's 17th Edition of their *AM Radio Log* is now available. Its 312 pages list the US and Canadian AM broadcast stations by frequency from 530-1660 kHz, with a cross reference by call letters and city. The listing includes the call, address, format, networks, phone number, day and night powers, antenna, time zone, and slogans. With 191 listed stations on 1230 kHz, a person could make a career out of logging everything on one frequency. The list comes on 8-1/2" x 11" paper, punched for a binder. The Club also has lists available of Latin American, European, and all other stations. Box 164, Mannsville NY 13661.

LETTERS

Continued from page 83

Last year, Bob Gobrick WA6ERB/VOIDRB and I sat in the QRP-ARCI hospitality suite and kicked around an idea we hoped would change this. Coming from engineering backgrounds, we both have extensive experience with technical conferences and trade shows. And what else is Dayton if not a trade show with a few technical conferences thrown in? We thought that a QRP technical conference would enhance everyone's enjoyment of the QRP activities, and perhaps even raise their level of technical knowledge.

We envisioned some of QRP's "great white heads" holding forth on topics of interest to all: what's the best antenna, what's the best band, how do radios really work, how do you build a radio, etc. We decided on the Thursday before the Hamvention opens. We thought there might be 20 or 25 of our fellow QRPers who'd use up an extra day of vacation and spring for the extra expenses. Surprise, surprise—we had 105 enthusiastic QRPers in the audience. Dayton Bombed? Not at the Day's Inn—Dayton South! Yes, we're going to do it again next year, and you have my personal invitation to attend, free, on me!

How can I pass up a free meal? Meanwhile, Bruce, the more articles I can publish on QRP, the bigger turnout you'll have, so let's see articles on QRP rigs, reviews of kits, and so on. What's the best backpack antenna?... Wayne.

Evan Rolek K9SQG. Your "How About Macs" editorial really got me going. Hams demand no-tune transceivers. They want automatic antenna tuners to match the impedance of their linears, keyers, voice synthesizers, automatic CW copiers, and motorized crank-up towers, so one might think that hams are lazy. But for some unknown reason they have an obsession with PCs and shun Macs. I heard a chap explaining proudly that it only took him two days to get his CD-ROM installed and working. With a Mac, even a novice can get a CD-ROM working in less than 10 minutes. I used to joke with PC users because, unlike with the Mac, they could only use eight characters to name files, and no uppercase, commas, blank spaces, etc. Now, with Windows 95© they're saying, "Hey, you know, I can name my files now!" Just compare the number of help books and help courses at local schools for PCs vs. Macs. Missed you at Dayton.

Golly, Evan, you convinced me!... Wayne.

Don Blackys K9UQN. I just got through reading your editorial called "Debacle?" in the September *73*. My response to your comments is that you are applying what happened to us as youngsters to a new time and place. That is difficult to do. In your opening paragraphs you speak of that nasty group called "hams" who provide the least in the way of benefits to the public in return for their use of billions of dollars of spectrum. Really? I started on the ham bands back in 1959 with a Novice license. Today I hold the amateur Extra, all four FCC Commercial licenses, a masters degree, and have the title Systems Design Architect and Engineer, Motorola Land Mobile Products Group. I am designing some of the most sophisticated digital encrypted land mobile products that will benefit an entire world of people. And those products encompass everything from better spectrum utilization to the most "uncrackable" encryption methods to be used for customers like United States Secret Service, FBI, US Border Patrol and US military customers. And where did it all start and where does it continue? With my love for radio, which was sparked by ham radio back in 1959. Our company has many hams working on hundreds of diverse projects to aid mankind now and in the future, and this includes using microprocessor controls for everything from the cars we drive to the microwave ovens we cook in. Where did these engineers get their start? Ham radio.

Yes, Wayne, it appears on the surface (to you) that amateur radio is becoming a waste. And if you look at Dayton on the surface, yes, there are some real lowlifes that are entering the hobby, but they are the same lowlifes that take up a slot in life, drink beer and don't give a hoot for their country and/or fellow man.

You made a statement that alluded to ham clubs not helping youngsters understand radio and electronics. Have you ever taught a class recently? I have taught over 400 people now everything from the Novice through Extra and the Commercial FCC exams. You know what everyone wants today? They want a license to either chat on the radio or get a job they won't be able to handle. It has nothing to do with ham radio: it has to do with the fundamental idea that our government in this country has encouraged: That failure is OK, reading books is boring, and you get a job just because you are a minority. The kick-ass, get-tough, dig-in-and-fight attitude is gone in the United States. Look at how simple the ham exams are today. I teach the no-code in four evenings and have had 75 students so far score no less than a 90 on any element they take. Where's the 1960 attitude of "Two-thirds of you just flunked your Extra theory (1) questions, of which 10 were draw-the-schematics)"? We have become a soft, give-away country, Wayne. Why not ham radio? Give it away to a bunch of morons whom the government can then control. That's the bottom line.

I go through this every day—seeing newly graduated engineers who got straight A's in engineering school not be able to tell me how RF energy gets from the transmitter to the antenna down a coaxial transmission line. They have no idea, yet when I check their records: An A in Fields class. Give the grades away so our colleges can remain in business.

Straying away from ham radio for a minute, I am also a private pilot with an instrument rating. I have talked to many of my ham buddies who fly as captains with major airlines. I have asked them point blank, "Is there a movement in the United States to get rid of private pilots in American airspace?" The answer has been a resounding "Yes!" Might as well, Wayne; they fit your guideline of "least benefits to the public in return for their use of billions of dollars of spectrum (airspace)."

Say what you want, Wayne, it's your magazine and your feelings. But don't blame ham radio. It has and will remain a vehicle for people to have fun with electronics and explore the field of RF communications. Who knows who the next engineer we hire will be. He might be the kid we are looking for to develop a new encryption method because he has been reading in depth on digital coding methods—something that was a spin-off of high-speed packet radio operation. I hope you will lighten up, Wayne.

Don, I'll lighten up when I see some articles coming in from you to help get the readers interested in pioneering ham digital voice communications. But my main message is that either we start cloning hams like you in quantity or we're goners. Sure, we have a few youngsters coming into the hobby and going for high-tech careers, but it's about one-tenth as many as we used to provide the electronics industry. Meanwhile the industry has grown by a hundred times, and shows no sign of slowing down. Don, I read a thick stack of ham club newsletters every month and only a few show any signs of serious recruitment and giving theory classes. Our kids' low grades and lack of motivation are a product of our government-controlled school system. If we can get the government the heck out of our schools (and a bunch of other similar expensive failures) we'll be a whole lot better off. Eventually if there's no quid, there isn't going to be any quo... Wayne.

Don Lawshe NW2S. In reference to obtaining adhesive-backed copper foil for antenna construction, any craft dealer worthy of the name handles this tape, generally in the "stained glass" section. My

Continued on page 86

Number 86 on your Feedback card

BARTER 'N' BUY

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

The deadline for the April 1997 classified ad section is February 12th, 1997.

LETTERS

Continued from page 85

local dealer has it for $3.49 for 12 yards. A nationwide distributor is Dick Blick Art Materials (800-723-2787); their item number is 606-3601, price $3.20 for 12 yards, plus shipping. However, be sure and get *copper* tape, not the lead tape some dealers also carry. The copper foil (tape) originally was intended to wrap the edges of "Tiffany" type stained glass ornaments and windows.

OK, antenna weather is here—still winter, so I want to see a bunch of "Curses, Foiled Again" antenna construction articles... Wayne.

Craig Roberts WB5HKO/1. I've just read your wonderful editorial on entrepreneurship. Good job! A year ago I was an out-of-work advertising copywriter and ex-radio announcer feeling terribly sorry for myself; abused by society and victimized by a "bad economy." My pathetic mood was exacerbated by the necessity of selling the contents of my modest shack in order to meet a mortgage payment. My God, evil and overwhelming forces had forced my to give up not only my dignity as a family provider, but the trappings of my beloved hobby as well. Things couldn't be worse! Woe was me. Then, during one of many telephone calls to "Help Wanted" advertisers I was put on hold. While in that telephonic limbo, I heard several minutes of informative promotional messages for the company I had called. "Hmmm," I thought, "I could do that. I could write, produce and sell telephone on-hold messages." The disciplines involved were well within my professional capabilities and the investment needed to get into the business was nearly zip. I excitedly told a few friends about my plan and was met by doomsaying: "Start your own business in conservative old New England? You must be mad! The economy's terrible and no one will buy your radical service!" Having nothing better to do, I persevered. I went door to door taking orders and small deposits. With the deposit money I rented some audio equipment and delivered on my promises. It worked wonderfully. Mine isn't the largest on-hold company in the country, but

Continued on page 87

Number 87 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

February is likely to be a rather "blah" month (again) for DX propagation due to generally depressed seasonal and cyclical solar flux values, which have hovered in the high 60s and low 70s for almost a year. However, it is expected that there will be favorable increases in solar flux—hence DX propagation—during late summer and fall.

On the brighter side, noise levels (QRN) should be fairly low this month, and few days are expected to present any great storm activity in either atmosphere or ionosphere. You may want to try your DX ability on the 6th, 11–12th, and 21–22nd while avoiding the days surrounding the 3rd, 17th and 27th.

Listen often to WWV at 18 minutes after any hour. The 10 MHz frequency is best for me but you may wish to try 5, 15 or 20 MHz for best reception at your QTH. Best "conditions" will appear when the "A" and "K" indexes are low (Boulder K less than 3 and A less than 10) with accompanying solar flux values moving upward into the 80s and 90s.

Don't give up...better times are coming, and the skills you develop now will stand you in good stead when propagation improves. W1XU.

10–12 meters

A few possible daytime F2 layer openings to South and Central America on the Good (G) days.

15–17 meters

Fair DX openings on Good (G) days between noon and sunset, and short-skip openings during the daylight hours. The band dies at sunset.

20 meters

DX to most areas of the world during daylight hours, peaking a few hours after sunrise and again during the early afternoon. Although the band usually closes soon after sunset, you may find occasional openings to South America and Antarctica until midnight. Daylight short skip from several hundred to 2,000 miles or so possible on most Good (G) or Fair (F) days.

30 meters

DX toward Europe in the late afternoon and evening on Good (G) days until midnight, and then toward the Orient in the early sunrise hours. Possible long-path DX in the morning and also short skip most days out to a thousand miles or more, and farther in the evening.

40 meters

DX toward Europe and Africa in late afternoon hours, toward South and Central America around sunset, and good openings to the West and South Pacific peaking around sunrise on Good (G) days. Expect daytime short skip to 1,000 miles, and 2,000 miles at night.

80–160 meters

Both are excellent bands for DX during hours of darkness, peaking at midnight and just before dawn. Daytime skip on 160 is nonexistent, but on 80 it can be up to 500 miles, and over 2,000 miles at night. On 160, short skip can reach from 1,000–2,500 miles at night. Experts prefer vertical polarization for transmitting antennas (low-angle signal take-off) and horizontal polarization for receiving antennas (less noise) on 160 meters.

FEBRUARY 1997

SUN	MON	TUE	WED	THU	FRI	SAT
						1 F
2 F-P	3 P	4 P-F	5 F-G	6 G	7 G-F	8 F
9 F	10 F-G	11 G	12 G	13 G-F	14 F	15 F
16 F-P	17 P	18 P-F	19 F	20 F-G	21 G	22 G
23 G	24 G-F	25 F	26 F-P	27 P	28 P-F	

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15	15
CANAL ZONE	15	20	20	40	40		20	20	15	15	15	15
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15	15
INDIA	20					20	40	20				15
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15	15
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15	15
SOUTH AFRICA			40	40				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						80	40	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15	20	20				40	20	20			
JAPAN						80	40	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40							15	15	20	20
U.S.S.R	40		40	40				20	20			

WESTERN UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40	40							15	15	20
U.S.S.R.		40	40	40	40				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

LETTERS

Continued from page 86

none offers better service or a superior product—and I've recently expanded my business to provide custom newsletters and collateral marketing materials for small businesses. I'm now totally self-sufficient and better off than ever financially. And my company's only a year old! The best is yet to come. As you so convincingly said: Yes! It can be done! On behalf of the many you will inspire—thanks!

All it takes is Motivation, Determination, and Perseverance and you can do just about anything. And I'd much prefer to hear something promotional than the crappy music most on-hold services use... Wayne.

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form below for ordering information.

Antenna Books

UE220 **The Easy Wire Antenna Handbook** by Dave Ingram K4TWJ. All of the needed dimensions for a full range of easy to build and erect "sky wires." $9.95

WGP87034 **All About Cubical Quad Antennas** by William Orr and Stuart Cowan "The Classic" on Quad design, theory, construction, operation. New feed and matching systems. New data. $13.95

TAB 3270P **Practical Antenna Handbook**-2nd edition by Jos. Carr. This 560-page book is a treasure. Starts with fundamentals, explains propagation of all kinds, and provides a ton of easy antenna projects. $29.95

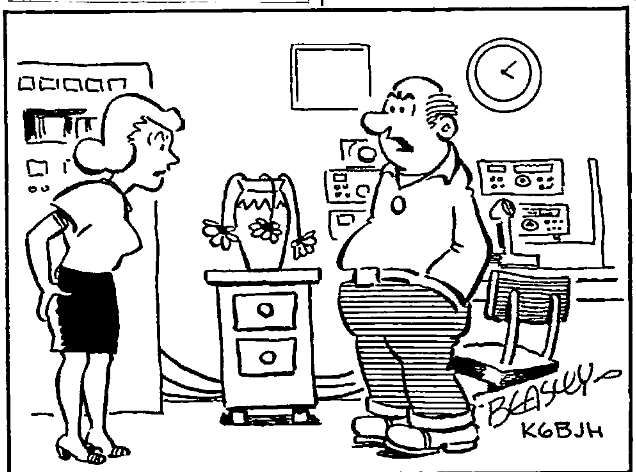
AR4734 **ARRL Antenna Book.** Best and most highly regarded info on antenna fundamentals, transmission lines, design, and construction of wire antennas. $30.00

WGP87107 **All About Vertical Antennas** by William Orr. Comprehensive coverage of amateur communications. $13.95

WGP87042 **Beam Antenna Handbook** by William Orr and Stuart Cowan. Everything you need to know about beam design, construction, and operation. $13.95

WGP87077 **Simple, Low-Cost Wire Antennas For Radio Amateurs** by Willliam Orr and Stuart Cowan. Low-cost, multi-band antennas; inexpensive beams, "invisible" antennas for hams in "tough" locations. $13.95

AR4661 **ARRL's Antennas & Techniques for Low-Band DXing** can be your ticket to low-band success. $20.00



NO, IT'S NOT HIGH-ENERGY ELECTRO-MAGNETIC FIELDS IN THE SHACK--- I JUST FORGOT TO WATER THE @#!!★ THINGS!

Number 88 on your Feedback card

HAM HELP

We are happy to provide Ham Help free on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double-spaced, on a full 8-1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully. A 1, for example, can be misread as the letters I, i, l, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Any Yaesu Hints?

I have a Yaesu FT-51R-HP Dual Band Transceiver with high power battery pack, digital display microphones and cigarette lighter adapters. The unit will not stay on high power but reverts to a lower power setting. How can I achieve the specified 5 watt output from this radio and how can I get it to stay on the high output setting of 5 watts when it is selected? Yaesu has already fiddled with this unit and returned it to me but the problem still occurs. Please respond to *George T. Platt N1UUN, P.O. Box 21, Guild NH 03754.*

Pirates of the Caribbean

The hams of Guantanamo Bay are in a quandary. Rusty Auxier KG4AU, President of the Guantanamo Bay ARC (KG4AN), writes:

"We have about four hams here who are active on HF, and it is sometimes difficult to QSL due to the fact that our club call, KG4AN, has been deleted from *Callbooks* for the last few years. I just received my copy of *Radio Amateur Callbook* on CD-ROM, and discovered my stateside call said 'QSL via KG4AN' but there was no address for KG4AN. Of course, people wishing to QSL can go through the bureau, but that adds a lot of extra time. The QSL route for any KG4?? hams is as follows:

G.A.R.C./ ATTN: KG4??
PSC 1005 Box 73
FPO AE 09593-0173.

"By the way, there are several pirates out there using KG4 callsigns. A few known ones are KG4AA, KG4AB and KG4US. Here is a list of the active hams who are live on the island:

KG4AU - Rusty Auxier
KG4WD - Wayne Duncan
KG4KD - Kim Duncan
KG4CQ - Tom Mann
KG4HE - Ray Magorno

"We do have visiting hams here on a regular basis, most notably KG4GC, Bill Gallier. If there is any doubt about the validity of a call, you can write us at the above address, ATTN: KG4AU, or for those hams on-line, the E-mail address is Rustman@AOL.COM."

Radio Bookshop
ORDER FORM

You may order by mail, telephone, or fax. All payments are to be in US funds. Allow 4 weeks for delivery. (Prices subject to change without notice if suppliers increase prices or new editions cost us more.)

ITEM	TITLE	QTY	PRICE	TOTAL

Shipping: All orders add $5.00 handling *plus there is an additional at cost shipping charge added to all foreign orders. We ship UPS where possible, please give us street address.

S&H* ______
TOTAL $ ______

Make checks payable to "Radio Bookshop."

Foreign Orders: Chose one ☐ surface shipping ☐ air shipping (Surface delivery may take 2-3 months.)

*Note: The actual foreign shipping costs will be additional to the regular shipping and handling fees.

Name ______ Phone ______

Address ______

City ______ State ___ Zip ___ Country ___

$10 minimum for credit card orders

Total Paid $ ☐ Check/Money Order ☐ AMEX ☐ MC ☐ VISA

Card # ______ Expires ______

Signature ______ Date ______

Telephone: 603-924-0058, 800-274-7373, FAX 603-924-8613

Mail: Radio Bookshop, Dept. 297, 70 Route 202 N, Peterborough NH 03458

☐ YES, Send me 12 issues of 73 at the low rate of $24.97 (save 47% over the cover price). Canada add $7 plus $1.40 GST; Foreign add $19 surface; $42 airmail.

Including Ham Radio Fun!

MARCH 1997
ISSUE #438
USA $3.95
CANADA $4.95

73® Amateur Radio Today

International Edition

ARRL Code Survey Exposed

ATV via Satellite

The TOP Antenna-
Power in a Small Package

The Secrets of Recharging Alkalines

Reviews:
KC2: Keyer- Counter-S & Wattmeter Combo
Dazzling New Satellite Tracking Software

GPS = Great New Toy!
see page 18...

THE TEAM

El Supremo & Founder
Wayne Green W2NSD/1

Associate Publisher
F. I. Marion

Associate Technical Editor
Larry Antonuk WB9RRT

Nitty Gritty Stuff
J. Clayton Burnett
Priscilla Gauvin
Joyce Sawtelle
David Underwood

Contributing Culprits
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Dave Miller NZ9E
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

Advertising Sales
Frances Hyvarinen
Roger Smith
603-924-0058
800-274-7373
Fax: 603-924-8613

Circulation
Linda Coughlan
Helen Senechal

Data Entry & Other Stuff
Christine Aubert
Norman Marion

Business Office
Editorial - Advertising - Circulation
Feedback - Product Reviews
73 Amateur Radio Today Magazine
70 Route 202N
Peterborough NH 03458-1107
603-924-0058
Fax: 603-924-8613

Reprints: $3 per article
Back issues: $5 each

Printed in the USA by
Quad Graphics

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM (ok) or Mac (preferred) formats), carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

73® Amateur Radio Today

Including Ham Radio Fun!

MARCH 1997
ISSUE #438

TABLE OF CONTENTS

FEATURES

REVIEWS

DEPARTMENTS

HAM RADIO FUN SECTION

Warning: Important construction correction—see page 88.

On the cover: John Williams N5SJZ launches the 500-foot antenna. Photo by Debby Williams N5SKA. Article begins on page 31.

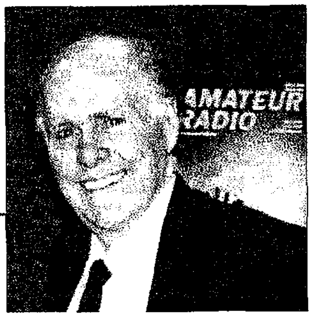
Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The entire contents ©1997 by 73 Magazine. No part of this publication may be reproduced without written permission of the publisher, which is not all that difficult to get. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

NEVER SAY DIE



Wayne Green W2NSD/1

School Finally Reinvented

As I keep mentioning (endlessly, I guess), our compulsory public school system really sucks. And (ugh!) it's getting worse. Having totally failed to get you to do anything about this miserable situation, I've been doing a lot of research. I've written about what's going on and made some proposals for improving things in my *Declare War* book, plus also in several segments of my *20/20 Foresight* series. I'm busy updating both of these out-of-print books, by the way.

Many schools have been experimenting with ways to improve things, and in most cases their ideas have been helping. You know, it's been shown actually possible, even in the worst inner city ghettos, to get parents actively involved in their children's education.

But the best model school for the future that I've heard about, by a wide margin, is the Sudbury Valley School in Framingham, Massachusetts. I'd class this as the best school in the country. No, probably the best in the whole world! It's a model of iconoclastic, innovative thinking. A reader suggested I look into the school so I sent for a book about it and, when I read it, I got really excited. I'd say this is probably the single most important book I've ever read.

How about a school with no classrooms, no regular classes, no grades, no tests, and no curriculum? How about a school that is so superb that every graduate desiring to go to college has been accepted by a college (usually the one of their choice), despite there being no grade transcripts available, or even a teacher evaluation? How about a school for kids from four to 18 where they learn what they want to learn, when and if they want to learn it, and with no pressure from anyone but themselves to enforce learning? Not even the parents! How about a school where kids can learn eight years of math in 20 contact hours—just because they want to? Where kids read voraciously because they want to?

For most things the kids teach themselves, but when they want help from a teacher it's available. The end result is a bunch of very self-reliant, self-motivated kids with top notch educations, kids who keep right on learning all through their lives.

Spend the $7 for the book, plus $2 shipping for *Free at Last* by Daniel Greenberg, and eat your heart out that you didn't have the opportunity to go to a school like this. Maybe it's time to start one in your town. Order the book immediately, before you forget, from Sudbury Valley School Press, 2 Winch Street, Framingham MA 01701.

Here's a school where every decision is made by the students and teachers together, where there are no administrators, no graffiti, where the students do all the maintenance, where there is no government funding, yet the school costs less than half as much as a public school per student, and yes, it's accredited.

The fact undiscovered by our public school teachers, teachers' colleges, and school administrators is that you cannot *force* children to learn. Oh, under pressure (via ridicule and humiliation) they'll memorize enough to pass tests. But 95% or so of that stuff is gone by the next semester.

In college I began to understand this. When I'd have a problem with a course I was taking I'd ask an upper classman in my fraternity for help. The answer was always the same, "Oh, I passed that course. I don't remember much of it. Sorry."

It really came home when I went back to college after World War II. I'd gone for two years before the War came along and the local draft board decided I would be of more value in the trenches than sitting around in class. So I joined the Navy. You can read more about my exciting adventures (we came tha-a-at close to being killed several times) in my *Uncle Wayne's Submarine Adventures in WWII* book.

During the first two years of college I suffered through four semesters of calculus. I really suffered. I hated it. I wouldn't have hated it so much if the teachers had been able to give me any idea of what I might be able to use it for. Yes, I kept asking, and it just made them mad. The best explanation I was ever able to get was that if I wanted to find out how big a sphere I could put into a cone, calculus would help. You know, it's never come up! Nor, in my 45 years of publishing technical articles, has there been any serious need for me to deal with calculus.

Anyway, after being away for four years, when I went back to college (paid for by the government under PL-16) I still had one more term of required calculus to go. The trouble was, when I opened my old calculus book to refresh my memory, I found I had no memory. It was just as if I'd never been through those two years of misery. So I spent my summer going back over the old material, re-memorizing a bunch of stuff that didn't make much sense. I had to "learn" it all over again. Grumble. And all that for a totally useless differential equations course, which mainly involved my memorizing hundreds of equations. We never were given any practical applications, so I still don't know what that was all about.

College was an agonizing blizzard of memorizing for tests. I have little recollection of anything that went in and out of my memory at the time. Nor has much of that ever been of the slightest value to me in life.

The Sudbury Valley School has shown that if you leave kids alone they are harder task masters than teachers ever would be. They learn what they are interested in, when they are interested. Not one of the "buts" you're going to come up with is valid in the real world.

Our public schools, as I've discussed before, were modeled on the Prussian military schools, whose purpose was to turn out obedient soldiers who would follow orders without question. But is that really what you want for your kids? Well, that's what you're getting, and you're going along with it.

Most of you are too old to have kids in school, but you do have grandchildren, so send for a copy of the book for each of your children. It'll be one of the best $9 you ever invested.

Oh yes, my university. When I was back there recently as a member of the RPI Council, I was assured by the president of the student council that nothing has really changed, that the university still operates on the basis of memorization and tests. And sure enough, they're still teaching classes with rows of desks and blackboards. Wow! Right out of the 19th century.

One Sudbury Valley School graduate put it this way: "Public school systems are set up as dictatorships, which is why children who develop in public school systems end up the same way that prisoners in prisons develop: they tend to become mentally sluggish and submissive." Hmm, so *that's* my problem!

Mooned Again

Yes, of course I realize that the whole idea of all those moon landings almost 30 years ago being a giant hoax is so ridiculous that Wayne Green is off his rocker for even reading about such nonsense. I used to figure that the 30% of the American public who didn't believe we'd ever been to the moon must be a bunch of ignoramuses. Then René's book, *NASA Mooned America* arrived one day in the mail.

Well, I get all kinds of weirdo baloney in the mail. The Iraqis

Continued on page 17

LETTERS

Number 6 on your Feedback card

From the Ham Shack

George Bergstrom, Rancho Cordova CA. Your appearance on the Art Bell show was fascinating. Being an electronics hobbyist I decided to build a "purifier" from your description. Here's the schematic I put together (**Fig. 1**). Your "AIDS Info" booklet recommendation to drink 8 oz. of water before and after is apparently important since I don't drink much water unless it has Sanka in it and ended up with two nearly painless boils on my back, which quickly cleared up. I've already noticed improvements in my skin and nails. I started with one salt pad at the ankle and the other just below the knee, but now I'm using one at the left arm wrist and the other above the elbow.

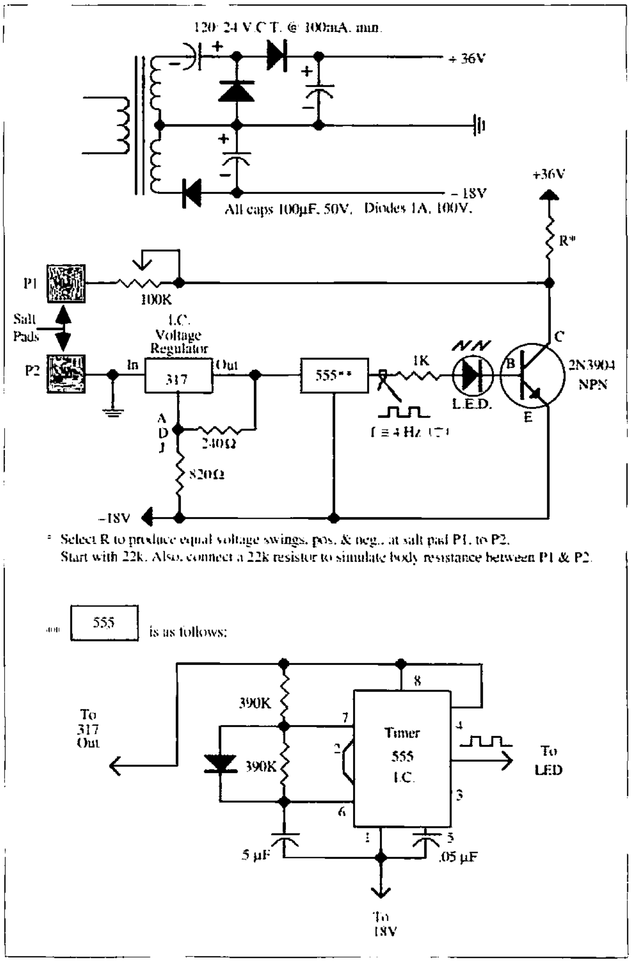


Fig. 1. George Bergstrom's purifier.

Ron Gang 4X1MK. As I look through the different amateur radio publications, indeed almost all of them, I see some interesting soul-searching. Ideas which not too long ago would have been considered heretical have now even popped up on the pages of the rather conservative *QST*. To sum it up: You can now pass messages and even voice to any spot in the world on the Internet. The financial outlay on the hard and software, plus local telephone calls, is cheaper than that of a ham station with good worldwide communications capabilities. And, of course, the Internet isn't affected by sunspots and doesn't cause TVI. Emergency communications? Cellular telephones are almost universal, so help can be easily summoned. No need to hope that someone else is on the repeater and can make a phone call for you when you're in trouble.

Now, as you probably know, this past spring we experienced some ghastly terror bombings. When the bombing massacre occurred at Tel-Aviv's Diezengoff Centre shopping mall during the Purim school holiday, the national telephone network became so overloaded by phone calls that the system crashed and all telephones were temporarily rendered useless. Hams jumped in to help on the Tel-Aviv 2 meter repeater, this being the only workable communications at the time.

A week later, after driving some friends to the airport, my car broke down. On the Tel-Aviv repeater one ham took care of the phone calls to my home while another ham, a mechanic in the general vicinity, drove over to where I was stuck to help me out. The day before that I was in Jerusalem, and accompanied by a non-ham friend, I dropped in to an informal ham get-together. My friend was impressed by the warm manner of the group, and commented on our way home, "You must be really good friends with all these people." Actually, I had only seen them face-to-face on a few occasions, but we had been talking together on the radio for years.

Then it hit me. Ham radio is much more than just a mode of communications. Ham radio is friendship. Ham radio is a fraternity. Ongoing contacts build a community of people who are not strangers to each other. Ham radio counters alienation. Thus the willingness to help each other, to host visiting amateurs from other countries. People is what ham radio is all about.

The actual mode of communications via radio was not long ago technically beyond the general public. But for most of us that was not necessarily the attraction of it. Now that the Internet and cellular phones have liberated amateur radio from having to be "useful," it is simple to see what distinguishes it from the former. Ham radio is an art form. We are into it because we like it for what it is. In the words of the "global village" guru Professor McLuhan, "The medium is the message." Long live ham radio!

Yep, Ron, we certainly have a great fraternity. Now all we have to do is convince the FCC and Congress that international conviviality is worth a few billion dollars worth of radio spectrum... Wayne.

Mike Miller WA8YKN. Just a quick update. I recently sent a Bioelectrifier to Dr. Val Hutchinson of Amarillo, Texas. Last night he called to say that while monitoring his body during using the device, that his temperature went up 1.5 degrees. This was repeatable. This might explain in part the results, since viruses and bacteria are easier to kill at an elevated body temperature.

I've been getting calls about successes with a variety of ills with the device, and no reports of failure so far... Wayne.

Ernie Stricklin, Cherry Grove AB. I just wanted you to know my results with the Bioelectrifier. I just used 2N2102 transistors in a multivibrator. Being silicon, they can stand up to 50V on the collector. I used 30V and took off from the collectors of the two transistors with electrodes made of two pennies with 68K resistors in series for pulsing my veins. It works perfectly and reduces the circuitry to just a multivibrator. If you use MOSFET circuitry the multivibrator can be two NAND gates in an IC. The results? Well, I don't have AIDS, but after less than two weeks I've gone from 183 pounds to 167, and I've never felt better in my life. It's a big relief to get rid of those extra pounds.

Curses, Foiled Again!

In the August issue I ran a letter from W4FA grumbling about

finding copper foil for making weenie antennas. Both W4FA and I should read the ads more closely, for there, on page 71, was an ad by Hamco, offering copper foil tape at reasonable prices. Call 303-795-9466 and ask Larry Feick. If you're too cheap to call, invest a lousy 32 cents in a letter to 3333 W Wagon Trail Drive, Englewood CO 80110.

Get yourself in gear and start peppering me with articles on the great antennas you've designed with this stuff. We're into good antenna weather, when there's lots of snow and ice to make antenna raising memorable. I know I'll never forget putting together a twin-three antenna in the yard of my fraternity house wallowing around in three foot of snow. Every time I put the soldering iron down it disappeared. But, hoo boy, did that antenna ever work out! I've put up some pretty big beams since then, but none have ever given me the reports I got with two of those wire antennas hung at 90° from each other from the fraternity house to trees on the edge of our yard. My ham station filled the basement.

Okay, you have your instructions. Design, buy foil from Larry, build, check it out, write, take some darned good pictures, and don't forget to send me a disk copy of the text... Wayne.

Phillip Holmes, Van Wert OH. Jim Gray gives more credit to HAARP than the project deserves. There seems to be some eagerness to attribute capabilities of Dr. Bernard Eastland's patents to this classified project. Unless HAARP is somehow manipulating the Earth's magnetic field to produce much higher energies than the system itself is broadcasting—well, the power is just not available to carry out the controversial aspects.

There is no doubt in my mind that a BLACK PROJECT EXISTS and has existed since at least the early 80s, that can do some very spectacular geophysical alteration for a variety of national security reasons. This black system is most likely space-based, operating in conjunction with the Space Shuttle fleet.

According to my local paper, dated 1991, atmospheric scientists from nine federal laboratories including Los Alamos and Philips Laboratory (the HAARP manager) created artificial Northern Lights and auroras in the Earth's magnetic field. A scientist called the displays "as bright as any phenomenon in the sky outside of the sun itself." This astounding airglow experiment would seem to require a much larger system than the proof-of-concept system that HAARP actually is! Without the attenuating effects of the atmosphere, a space-based system could be smaller, require much less power and be highly portable.

From my study, I believe Challenger, 41-C, in conjunction with Solar Max, carried out a classified deep-Earth tomography mission, utilizing the natural electrical forces of the Earth (the polar electrojet) on 9 April 1984, near the Kuril Islands off the northeast coast of Japan, over Soviet territory. The goal of the mission was to locate a secret underwater submarine pen housing the then new titanium-hulled Typhoon missile boat by using an ELF radio-wave technique. There was a spectacular geophysical anomaly that appears to be related to this mission—The Mystery Cloud of 1984. Hope you find this of interest.

Jeff Anglesey KB7TJM. Your magazine is most excellent, and I buy it instead of *CQ*—too boring. Your technical contributing editors are great. Each issue always has something I can use. How about doing an article on low budget satellite operating? I use an HTX-202 running 5 watts to a 5/8-wave mag mount for the uplink and an AOI AT-400 HT and homemade 6-element yagi for the AO-27 downlink.

You forgot to mention how much you enjoy my editorials... Wayne.

David Borba KC6UMX. Great magazine! I first heard Wayne on the Art Bell (W6OBB) radio show, bought one of his magazines and was hooked. It is educational finding grid squares from coordinates, and the *Radio Fun* section describing types of emissions, and also it is open forum—like W5UOJ's treatment of closed repeaters in the July issue—something I always agreed with, but never said anything about because I thought it was "status quo." I would rather see a magazine like this with articles on HAARP, Tesla, cold fusion and other diversions from radio than to read a magazine with pages and pages of contest news and name lists. Hang in there, Wayne, I want to read "Never Say Die" for many years to come.

Non illegitimi carborundum... Wayne.

Michelle "Missy" Hollenbeck AAØOF. Today, Joseph, one of my eighth grade students, just passed the Novice theory test and the 5 wpm code test. Joseph, his family, his classmates, and the area ham radio operators (including me, of course!) are proud of his accomplishments. Joseph has learned that patience, practice, and extraordinary work do bestow a sense of self-satisfaction.

I'm writing you, Wayne, to reassure you that my students are exposed to as much technology as possible. I know that you are truly concerned about today's youth involvement in amateur radio.

Many skeptics say that the Internet will replace amateur radio, but in my classroom, the Internet and amateur radio work hand-in-hand. All the great things that we do in amateur radio are "highlighted" on the

Continued to page 63

QRX . . .

New FCC RF Safety Rules

As of the beginning of 1997, hams are responsible for new exposure limits (see Table 1). Maximum Permissible Exposure (MPE) limits have been set for electric and magnetic field strength and power density for transmitters operating between 300 kHz and 100 GHz. This ends a long waiver of these limits for ham operators.

We must ensure that if our stations operate with more than 50 watts of output power the listed MPE limits are not exceeded.

TNX to *Hill Country ARC Newsletter*, December 1996.

FEMA Backs Hams On Spectrum Sharing

The Federal Emergency Management Agency, better known as FEMA, is saying no to sharing or reallocating the 2m and 70cm ham bands to Low Earth Orbiting satellites. In a letter to the FCC task force currently evaluating new spectrum for use by LEO satellites, FEMA Manager Paul Reed tells the committee that his agency opposes any such change.

Reed says that Amateur Radio operators have a history of supporting state and local government emergency operations by providing needed communications. He says that many local communities served by ham radio have extremely limited resources and would be without any form of backup communications without Amateur Radio.

Reed says that FEMA has been in contact with its state and local emergency management partners across the nation. It is their belief that authorizing access to the mobile satellite service in the 2m and 70cm bands will seriously degrade the ability of these groups to support their public service requirements.

The FEMA Manager ends his letter by strongly urging the FCC task force to remove both of these ham bands from any further consideration as a new home for Low Earth Orbiting Satellites. He says to leave them for use by ham radio and its emergency service partners nationwide.

From *The Tuned Circuit*, monthly bulletin of L'Anse Creuse ARC. Utica MI, January 1997.

Limits for Occupational/Controlled Exposure (Environments where people are aware of the potential for exposure and can exercise control over their exposure)				
Frequency Range (MHz)	Electric Field (V/m)	Magnetic Field (A/m)	Power mW/cm2	Averaging Time (min)
0.3 - 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	(900/f)*	6
30 - 300	61.4	0.163	1.0	6
300 - 1,500			f/300	6
1,500 -100,000			5	6
Limits for the General Population/Uncontrolled Exposure (Environments where the general public may be exposed)				
0.3 - 1.34	614	1.63	(100)*	30
1.34 - 30	824/f	2.19/f	(180/f)*	30
30 - 300	27.5	0.073	0.2	30
300 - 1,500			f/1,500	30
1,500 - 100,000			1.0	30
f = Frequency in MHz * = Plane-wave equivalent power density				

Table 1.

Iran May Issue Ham Tickets

Iranian hams may soon be heard on the air. The British Broadcasting Company's monitoring service reported in November that the Iranian Ministry of Post, Telephone and Telegraph soon will issue Amateur Radio licenses to Iranian citizens. The BBC quoted the Teheran-based English-language newspaper *The Iran Times*. According to the report, the Iranian Ministry has invited radio enthusiasts over the age of 16 to sign up for special Amateur Radio license training.

From December's *The Garden City Wireless*, newsletter of Garden City ARC, Garden City MI, who got it from *Amateur Radio Newsline*.

(*Will women be licensed as hams in Iran, too?* —Ed.)

Does Your Bread Land Jelly-Side Down?

- Mobile antennas fail in the first 100 miles of a 1,000 mile trip.
- Manuals mysteriously disappear just before you want to sell a radio.
- Sellers always have whatever you want back at the shop.
- Rotors fail on contest day at 2 AM.
- As a seller, you never arrive early enough at the hamfest for a cool shady spot.
- You never have the correct value replacement fuse.
- Battery chargers are always left at home.
- CW is never slow enough to copy at Field Day.
- No two Atlas 210s work the same.
- You always find that other lost gizmo while you're looking for the first lost gizmo.
- The accessories for your old HT or mobile are never compatible with your new HT or mobile.
- Elements of antennas that need to be adjusted are always just beyond your reach from the top of the tower.
- Women and children grasp CW faster than the OM.
- The polarity of the radio's power cord connector of the unit you want to demo is always wired opposite to the one you have with you.

Borrowed from October 1996's *Squelch Tale*, newsletter of the Chicago FM Club, who lifted it from WCRA's *Stray RF*.

New FCC Web Searcher

The FCC has installed a new search engine for use on its World Wide Web site at http://www.fcc.gov. It supports both concept and keyword searches to help Web users find FCC documents quickly and easily. The search utility also supports Boolean operators (and, not, or, etc.). Details on how to use the new search tool are located on the search page, http://www.fcc.gov/search.—[de] FCC.

Taken from November 1996's *Squelch Tale*, newsletter of the Chicago FM Club.

Continued on page 81

Getting Ready for Phase 3D

Start now to be prepared for amateur radio's next great adventure.

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

Phase 3D is the largest, most complex international hamsat project to date. This amateur radio satellite is currently under construction and in final test at the AMSAT lab in Orlando, Florida. It is scheduled for launch from French Guiana in July on board the Ariane 502 booster. This will be the second flight of an Ariane 5 rocket, hence the "502" designation.

The first flight of an Ariane 5, on June 4, 1996, failed. Only 37 seconds after ignition, at an altitude of 12,000 feet, the launcher veered off its flight path, broke up and exploded. This has caused significant delays for the flight of Ariane 502. An inquiry board investigated the failure, furnished an analysis and provided recommendations for subsequent operations.

The Ariane 501 flight exhibited nominal behavior up until 36 seconds after initiation of the flight sequence. At that point there was a simultaneous failure of the two inertial reference systems, which caused the nozzles of the two solid-rocket boosters, and then the main liquid-fueled engine, to swivel into an extreme position. This made the rocket veer abruptly and triggered an automatic self-destruction sequence due to the rupturing of the electrical links between the solid boosters and the vehicle core.

The post-flight analysis report from the independent inquiry board concluded with, "The failure of Ariane 501 was caused by the complete loss of guidance and attitude information 37 seconds after start of the main engine ignition sequence (30 seconds after lift-off). This loss of information was due to specification and design errors in the software of the inertial reference system. The extensive reviews and tests carried out during the Ariane 5 development program did not include adequate analysis and testing of the inertial reference system or of the complete flight control system, which could have detected the potential failure."

Spaceflight is risky business. AMSAT's Phase 3A spacecraft was lost on the second flight of an Ariane 1 booster 17 years ago. When the Ariane 501 booster failed last year, it was a major setback to the European space program. The loss was estimated at nearly a half billion dollars. The Ariane 5 program is pivotal to the planned manned-space activities from Europe. The success or failure of the Ariane 502 launch will determine whether Europe moves forward with their ambitious goals, or regroups. The launch campaign will begin on Wednesday, April 9th. Efforts to ensure that all goes well are at an all-time high.

"Spaceflight is risky business."

Then and now

The Amateur Satellite Program has come a long way since the launch of OSCAR-1 on December 12, 1961. OSCAR stands for Orbiting Satellite Carrying Amateur Radio. OSCAR-1 was built by Project OSCAR, a West Coast group. The launch took place only four years after that of Sputnik-1 from the Soviet Union. OSCAR-1, weighing in at 10 pounds and costing about $64, carried a 140 milliwatt CW beacon transmitting "HI" on 145 MHz. The transmissions lasted 22 days till the satellite re-entered the atmosphere from its very low Earth orbit.

Since then there have been many amateur satellites: some simple, and others supporting many complex experiments and transponders. We have had satellites with CW telemetry beacons, several with analog transponders like repeaters in the sky, and others with complex, digital store-and-forward flying BBSs, or radio bulletin-board systems.

Work on the Phase 3 series of hamsats began in 1975. While Phase 1 satellites were designed for low orbit and short life, and Phase 2 types were low orbit and long life, Phase 3 was initiated to provide high elliptical orbits, long life and reliable communication. AMSAT-OSCAR-10 (Phase 3B) was the first Phase 3 satellite to achieve orbit. It was launched in 1983. Although the batteries have quit, the satellite still works when the solar panels are properly illuminated. AMSAT-OSCAR-13 was sent to orbit in 1988. Due to the gravitational effects of the moon and sun, it re-entered the atmosphere in December 1996.

When Phase 3D achieves orbit it will be given an OSCAR number. It is much larger, heavier, more complex and more expensive than its predecessors. The main body is nearly seven feet in diameter and three and a half feet tall. With solar panels extended, the wingspan is over 20 feet. The satellite weighs in at around 500 pounds with an estimated program cost of 4.5 million dollars.

Support for this immense program comes from AMSAT groups around the world. No one ham organization has the resources to plan, build and get a ride to orbit for a satellite of this magnitude. Funding for Phase 3D is

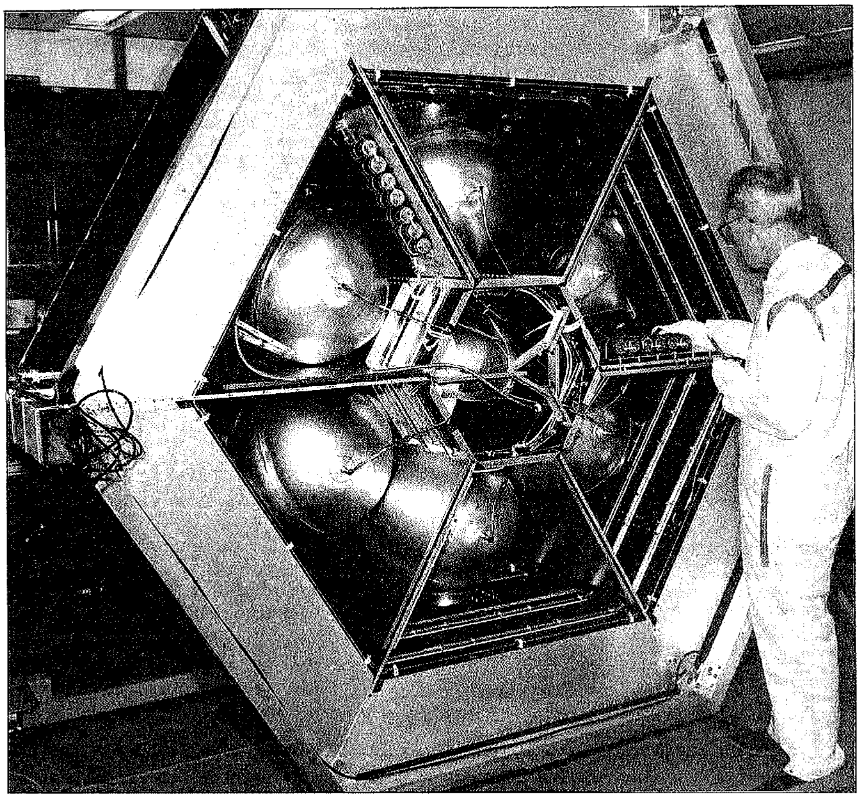


Photo A. Dick WD4FAB adjusts the mockup battery pack on the -Z axis of Phase 3D.

derived from membership dues, individual and corporate donations. The American Radio Relay League has been instrumental in financial support of the 1.5 million dollars (cash, labor and components) pledged by the North American AMSAT.

What is AMSAT?

AMSAT is a worldwide assembly of amateur-radio operators who share an active interest in building, launching and then communicating via non-commercial, amateur radio satellites. The collective groups of AMSAT organizations and companies around the world have been responsible for the design, construction and coordination of over two dozen amateur radio communications satellites in the last 28 years.

The original AMSAT (Radio Amateur Satellite Corporation) was founded in 1969 in the District of Columbia as a non-profit, educational organization dedicated to fostering amateur radio's participation in space research and communication. The first project for the new corporation was getting a launch for Australis-OSCAR-5 in 1970. This was to be the last Phase-1-type satellite, i.e., low-Earth-orbit and short life. Today AMSAT still exists as a non-profit organization with the same objectives and goals—the satellite design, construction and control continues.

> ***"Phase 3D uses a unique 3-axis platform stabilization system in conjunction with two hexagonal rings of computer-controlled magnetorqueing rods."***

Our North American AMSAT provides a vast array of services to support those interested in learning about amateur radio satellites. To help track each satellite, the AMSAT Software Exchange makes tracking software available for most popular personal computers. AMSAT also runs its own QSL bureau and awards program for satellite users.

The AMSAT Field Organization is ready to help those looking for information on a more personal level. With over 150 Area Coordinators, there are some in most localities willing to answer questions about the satellites, arrange for demonstrations or provide talks for local clubs and ham conventions.

AMSAT sponsors regular HF nets with the latest news on satellite activity and Phase 3D progress. One of the most popular nets is held every Sunday at 1900 UTC on 14.282 MHz USB. In addition there are many VHF nets around the country with similar information coverage and supplementary local items of interest. One local net, The Houston AMSAT Net, can be heard across most of North America at 8 p.m. Central time via SBS-6, Transponder 13B, 6.8 MHz audio subcarrier. It is also carried by various VHF and UHF repeaters in addition to a 160-meter retransmission every Saturday night at 9 p.m. Central time on 1860 kHz AM from WAØRCR in Missouri. For those who cannot get the satellite feed or the other local sources, there's the Internet. The Houston net is recorded for off-line listening via Real-Audio. The easiest way to get this service is to go to the URL (Universal Resource Locator) http://www.amsat.org. Find the link to "other sites," and check out "The Houston AMSAT Net."

Lots of current AMSAT information is available at www.amsat.org. There is also an FTP site at ftp.amsat.org, and up-to-date discussions about Phase 3D and other topics can be checked out by subscribing to AMSAT-bb@amsat.org. Just send a message to listserv@amsat.org to subscribe. This is not an automatic system. Paul KB5MU handles all subscribe and unsubscribe requests by hand. More information about AMSAT, telephone BBSs and nets can also be obtained for a self-addressed, stamped envelope to AMSAT, 850 Sligo Ave., #600, Silver Spring MD 20910.

Phase 3D overview

Phase 3D is designed as a replacement for A-O-10 and A-O-13, with

some significant extras. Key points include the orbit, the transponder scheme, the spacecraft orientation system and some exciting experiments.

The final orbit for Phase 3D is to be elliptical with a perigee, or low point, of 2,400 miles, and an apogee, or high point, of 29,000 miles. The apogee will always occur over the northern hemisphere. There are several steps required to reach the final orbit. After launch, Phase 3D will be in a geosynchronous transfer orbit with a very low perigee just over 100 miles and an inclination with respect to the equator of about 10 degrees. The main 400 Newton motor on Phase 3D will be used to bring the perigee up to 2,400 miles. Another firing will raise the apogee to 29,000 miles. A final firing of the main engine will be used to raise the inclination to 60 degrees. Over a period of two years the ammonia arc-jet motor ATOS(*Arcjet-Triebwerk auf OSCAR-Satellit*) will be used to adjust the final inclination to 63.4 degrees. This small motor (100 millinewtons) will also be used for minor orbital changes. The final orbit allows the ground track and rise and set times of the satellite to repeat every 48 hours.

Of the many facets of Phase 3D, Integration Manager Lou McFadin W5DID finds the transponder matrix to be one of the most exciting. Unlike previous satellites, Phase 3D has an array of radios from 21 MHz up through 24 GHz. The satellite receivers are on 21, 145, 435, 1268, 1269, 2400, 2446 and 5668 MHz. The transmitters start on 29 MHz and continue with 145, 435, 2400, 10451 and 24048 MHz. Transmitters and receivers are paired via ground control, with one exception—a transmitter cannot be paired with a receiver on the same band. The opportunities for some very interesting combinations abound and are augmented by the satellite's ability to run multiple combinations simultaneously or to match one receiver with multiple transmitters, or multiple receivers with one transmitter.

The transmitters and receivers on Phase 3D are connected to gain antennas that will greatly enhance

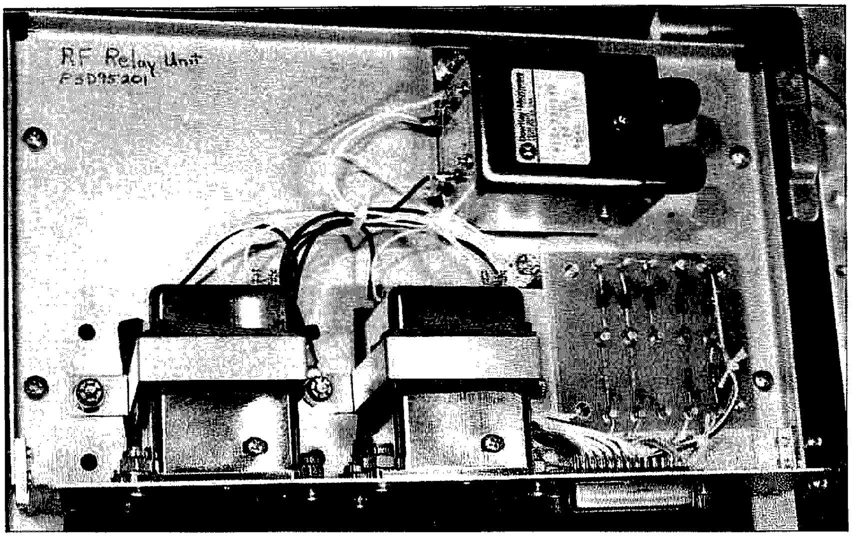


***Photo B.** RF relay assembly mounted in side 3 of the Phase 3D spacecraft. All photos courtesy of AMSAT.*

communications for those on the ground. Most onboard systems provide at least a 10 dB improvement over the previous Phase 3 satellites. This means that omniantennas will work in place of beams in many cases. On some bands the improvements will be dramatic. One of the two 10 GHz transmitters runs 40 watts to a horn antenna. A surplus DSS TV dish with appropriate hardware may be able to pick up these signals. Small "stealth" Earth stations will be a distinct possibility.

Phase 3D uses a unique 3-axis platform stabilization system in conjunction with two hexagonal rings of computer-controlled magnetorqueing rods to control both the spacecraft's attitude and spin rate. Phase 3D will not be spin-stabilized after the solar panels are deployed. Three magnetically suspended reaction wheels mounted at 90 degrees to each other are used to keep the craft properly oriented. Commercial TV satellites depend on precise and expensive bearings for their reaction wheels; Phase 3D uses a combination of rare-earth magnets and electromagnets to suspend and spin up the wheels. Each wheel is expected to consume about five watts of power for a total consumption of 15 watts.

A few of the experiments on Phase 3D include the Japanese SCOPE (Spacecraft Camera experiment for Observation of Planets and the Earth) and an array of GPS (Global Positioning System) receivers. SCOPE includes two high-resolution image sensors to provide a wide-angle and zoom view to take pictures of the Earth. The GPS experiment has changed in the last year due to difficulties with implementation of the AMSAT GPS receivers. The current system includes a pair of Trimble TANS Vector units. Each has four antennas and consumes about 7 watts of power.

Numerous papers have been written with in-depth descriptions about the features of Phase 3D. A good recent one, "Phase 3D Update," by the Phase 3D design team, compiled by Dick Daniels W4PUJ, appeared in the *Proceedings of the AMSAT-NA 14th Space Symposium and AMSAT General Meeting*. This publication, dated November 1996, contains many articles on current hamsat topics and is available from the American Radio Relay League or AMSAT for $12.00.

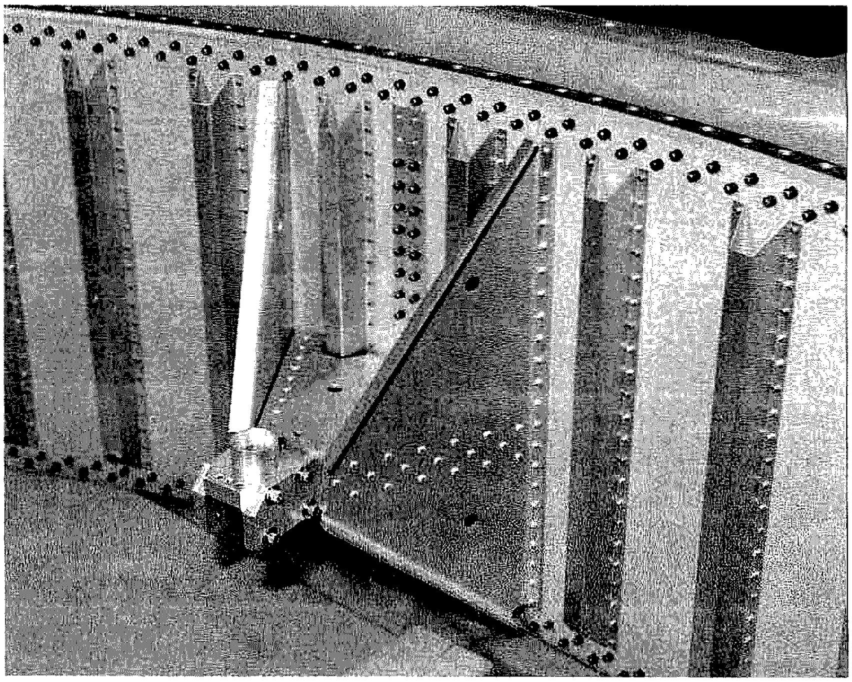


***Photo C.** Close-up view of one of the four spacecraft mounts inside the SBS ring.*

Phase 3D project status

Late last year, efforts were underway to complete all aspects of the satellite, test it, and ship it by the end of February 1997. With the recent launch delay (from April to July), more time is available to finish integration and get everything ready. A few of the December activities included work on the gas generator controller and the command arbitrator module. The SEU (Sensor Electronic Unit) had been received and work was underway to adjust antenna locations for the new Trimble GPS units. Several receivers and transmitters were scheduled to be at the lab

soon and some circuit boards for control units were nearly finished. The SBS (Specific Bearing Structure) is complete and has been approved for use on the launch. Phase 3D is to be placed inside this cylindrical structure. A conical adapter will then be bolted on top of the SBS. This will allow another satellite or test system to be mounted above Phase 3D in the payload stack.

The few remaining months before launch promise to be exciting but hectic. In order to properly test the GPS system, the satellite must be able to "see" the GPS satellites. That means that Phase 3D must be taken out of the clean room, or the clean room must be moved outside, or the antennas must be remotely located during tests. The same situation exists for a full test of the complete communications transmitter/receiver and antenna system. There are still issues to be resolved, but with dozens of successful satellites on the roll, the collective worldwide AMSAT will invent methods to handle the situation.

Getting ready for Phase 3D

Time is running out, so get your station ready for Phase 3D. After launch there will be a month or two of study and control efforts before the communications channels are opened for use. This will be a good time to monitor telemetry from the satellite. The 70 cm beacons on 435.450 and 435.850 MHz will be most likely to be used by ground controllers for satellite monitoring. After release, some restrictions will be placed on operation during periods when the ammonia arcjet motor is on, due to its high power consumption and RF noise generation.

Note: If you are not familiar with hamsat communications, you may want to start with the easier satellites, like RS-10, RS-12 and A-O-27.Then progress to the high-orbit world of A-O-10. Check out the entry-level articles presented in the "Hamsats" column during 1996. 73

DXing 10m FM From Perth

The sunspots are rising, so 10m will be coming back.

Graham Rogers VK6RO
22 Grace Street
Ferndale, Western Australia 6148

At the Perth International Airport, Western Australia, sitting in the waiting room of the international arrivals section opposite the customs exit door in April 1993 was an exciting time for me as I was about to welcome Bill G4TQV and his XYL Jean to Australia. Bill and Jean had flown 12,000 miles to visit and this meeting was the culmination of our many contacts on 10m FM since 1988. If it had not been for my keen interest in FM HF DX I would never had met young Bill.

I have had a great time working many UK stations over the years, many of them mobile, using just a few watts from modified UK CB FM rigs. Back in the early 1980s I would hear all these wobbly signals just above 29 MHz on my SSB-CW rig. I was intrigued as to what was going on; then I discovered they were JAs making local contacts.

Not many rigs in those days were fitted with FM on HF. In 1982 I invested in a Kenwood TS660, plugged it into my 2-element 10m quad and called CQ DX on 29.600 MHz. To my great surprise JE6QJV came back to me and we exchanged 5 x 9 reports. I was hooked!

We all know FM is used on 2 meters for local work and here I was talking to Japan on FM. The technical aspects of FM on HF make for rather interesting propagation and signal reception. Phase distortion or the capture effect can make signals hard to copy and stronger signals can completely swamp weaker signals.

I have used as little as one watt and had nice contacts with friends in the UK. An output power of 50 watts seems sufficient for working most DX. On this band the power doesn't seem to make a lot of difference. I've worked many mobile stations around the world who were running 10 watts or so to a modified CB rig.

Lengthy rag chews are not uncommon over great distances. I even worked Bill G4TQV/M through several countries over a 2-hour period as he drove across Europe, with his callsign changing as he crossed borders. Bill surprised me by becoming GM4TQV/M as he entered Scotland on several occasions. Other regulars were Bill GØRUB and Jan PA3FAO. Then there was Roomy VU3RMS, who often surprised me with a booming signal when I thought the band was dead.

There's no shortage of DX. I worked 1SØXV in the Spratley Islands for my 100th country. Some of the rarer stuff I've worked has been A2, A9, BV, BY, CN, CU, EA6, EA9, FT8X, FT8Z, H44, HZ, J2, KX6, SV5. TA, TL8, VQ9, XX9, T30, S21, 5X, Z21, V51, 3B8, 3B9, 3D6, C21, 4S, 5H, 5W, 7Q, 7X, 8Q, 9J, 9M2, 9M8, KH8, 9Q5, 9V, etc. I'm now at 132 worked on 29 FM.

The international calling channel is 29.6, but don't use it for rag chewing, just calling. Hey, don't forget to listen for me on 29.6, or talking away on 29.51.

Repeaters

There are a number of 10m FM repeaters around the world—DU, W, JA, VK. They mostly use 29.6 input and usually output on 29.7. Some use 88.5 Hz or a 1250 Hz tone burst (Ed. note: the Boston repeater inputs on 29.62 and outputs on 29.52). Some repeaters are linked to 2m, so you can find yourself talking with someone using a 2m HT. 73

NEVER SAY DIE

Continued from page 4

are about to spread anthrax all around America, killing millions of people. Aliens will be here in a 100-mile-long spaceship on December 17th. You name it, I get 'em. But, being pragmatic, I sat down and read René's book. He presented one scientific fact after another, undermining my faith in NASA's credibility. It sure seemed like he had made an airtight case for the Apollo missions to all have been a giant hoax.

My next step was to write an editorial about it so others could read René's book. I wanted to see if they could find holes in René's scientific logic. Now, with several hundred *73* readers having read the book, I don't think I've had anyone seriously challenge René's data. Could it be that it's the believers in the moon hoax who are the ignoramuses?

And, as I've reported, I've had letters from several readers who have been involved with either NASA or a NASA supplier, and who also have had their own serious doubts about the moon landings. One chap who helped build the LEM unit said that no one at his company that he knew believed for a minute that the flimsy module they'd made could have possibly made the trip. I got similar letters from hams who'd worked for other suppliers.

I heard about another earlier book which was similar to René's, *We Never Went to the Moon*, by Bill Kaysing. This, too, is self-published, since the publishers he approached with the manuscript were afraid to touch it. Who needs the CIA, DIA, FBI, IRS, NSA, and so on down the alphabet on your case? Plus there are too many dead whistle-blowers when people start to reveal government secrets.

It took me a while to track Bill down and get a copy of his book. It's 8-1/2" x 11" and runs 200 pages. And while Bill makes a few of the same points René does, he mostly has his own set of reasons for doubting the reality of the moon missions. He does a good job of explaining how the whole deal was pulled off, and the secret base in Nevada where the filming was done. He also points out the incredible series of accidents that killed so many astronauts just before the Apollo missions—something that didn't happen before and hasn't happened since. Were they reluctant to go along with the charade?

Then there is the strange death of Tom Baron and his wife. Not long after Tom blew the whistle on the Grissom "accident" his car "stalled" on a railroad crossing and they were killed. Even though the state law requires autopsies in all accidental death cases, his and his wife's bodies were hurriedly cremated. When's the last time your car stalled? And imagine this managing to happen on a railroad crossing just as a train is coming. What are the odds? And what happened to Baron's 500-page report which has now totally disappeared? For that matter, how come NASA's Apollo records, while not classified,

Continued on page 38

The Whole World—In the Palm of Your Hand!

And you thought 007 had some neat stuff.

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
dmiller14@juno.com

The government's acronym GPS is for their NAVSTAR GLOBAL POSITIONING SYSTEM constellation of satellites—21 navigational satellites, along with 3 spares, slowly circling the Earth, twice in a 24-hour period. With a hand-held GPS receiver, about the size of a current dual-band amateur HT (and costing roughly the same), you can determine exactly where you are, anywhere in the world.

GPS is fun!

Ham radio operators have always been curious by nature. That's pretty much how the hobby started; curious private citizens picking up the necessary parts and pieces, assembling working transmitting/receiving stations just for the fun of becoming involved in an emerging technology (and that was before anyone knew what "emerging technology" meant!). If you've ever regretted the lack of really new fun things for the ham experimenter to tinker with, take a closer look at GPS and APRS, the Global Positioning System and Amateur/automatic Packet Reporting System. APRS is an already growing branch of GPS that has some fascinating ham radio applications. I'll bet you knew that somehow we hams would be involved; we can't let a curious new technology get away! (For a detailed article on APRS, take a look at the excellent piece written by Bob Bruninga WB4APR in *73 Amateur Radio Today*, December 1996.) I'll try to introduce you, if you haven't already looked into APRS and GPS, but my approach will be a little different. Instead of just briefly mentioning what features are available on a current GPS receiver, I'll try to describe what it's actually like to operate one. Too many articles use terms and descriptions that can only be understood by the actual owners of the equipment being described—but that doesn't help the folks being exposed to the idea and the equipment for the first time.

Why do I need it?

If we hams need to ask, then perhaps we've lost some of that inherent ham curiosity. As a good friend of mine, K9KPM, always says, I suppose I don't really "need" very much of any of the electronic gear that I have, but if I enjoy having it, that's reason enough! Ken's right—what do we really need? Ham radio, and its many-faceted side interests, are interesting in and of themselves; they don't have to be justified. They're usually educational, recreational, sometimes even inspirational, but most often, they're just fun things to do. When it comes to new toys, most of us are just little boys in bigger jeans! For those who don't understand that kind of need, there are lots of other ways for them to fill their time ... anyone for stamp collecting? So if you can assume that mindset while reading this piece, not one centered on absolute need, but rather on learning a new science and perhaps applying it to amateur radio, then you'll understand. This concludes the lecture!

By the way, I can remember Uncle Wayne writing in his editorials about the fun that he had a number of years ago participating in sports car road rallies. Too bad GPS wasn't around back then—I'll bet he wouldn't have asked about a need!

The government's satellite system

The U.S. Department of Defense does have a definite need for accurate navigational positioning information; U.S. troops in all corners of the world must know exactly where they are for strategic and logistical reasons. Army troops, Navy ships, Air Force planes and Marine battalions in the field have a need to know exactly where they are at any given moment in time, so our government committed to a new, highly accurate system for navigation that they termed GPS. Unlike the older ground-based systems of Loran C and Omega, or the peripatetic early Sat-Nav navigational satellites, the NAVSTAR GPS constellation is available 24 hours a day, worldwide, and isn't affected by static, stormy weather or outside radio interference. In all honesty, there can be the occasional ionospheric anomaly that will absorb, scatter or duct even a microwave band signal, but as we hams know, these anomalies are rare. NAVSTAR GPS does operate in the microwave region at 1.575 GHz, using spread-spectrum formatting (see Peter Stark K2OAW's treatment of spread spectrum in *73 Amateur Radio Today*, December 1996). The NAVSTAR satellites are in polar orbits about 10,900 miles up, so very few ground-based interference sources bother it.

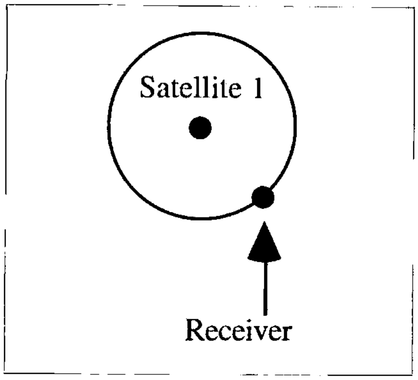


Fig. 1. The signal from one satellite doesn't tell you much – maybe just how far away it is from your position.

The constellation presently consists of 24 satellites and five ground stations at different venues around the globe. Of those 24 NAVSTARS, 21 satellites are kept active; the remaining three are orbiting spares. If one or more of the active satellites becomes "unhealthy," a spare can be moved in to take its place so that the full constellation remains operational. The ground stations monitor the accuracy of the system, and perform adjustments as needed. The government seems fully committed to maintaining the system, which began deployment in 1984 and has been estimated to cost somewhere in the neighborhood of $10 billion; the yearly maintenance alone is some $500 million or more. At those figures, it almost seems unpatriotic not to fully utilize it!

The GPS concept is workable from orbiting satellites because it's possible to receive exact positional data when a ground receiver can lock onto several satellites at the same time; when those satellites are located at different points in the sky; and when the receiver can triangulate a positional fix by receiving accurate geographical and time data from those satellites.

Let's break down those "whens" a little further. When the receiver knows how far away each satellite is, where it is, and what the exact time is, an imaginary circle can be drawn around each satellite being tracked. The receiver is located where those imaginary circles intersect.

Fig. 1 shows where the signal from a single satellite (the circle) would intersect your ground receiver. The signal from just one satellite doesn't tell you very much; perhaps only how far away the satellite is from your location (determined by the time it took for the signal to arrive). If two satellites are being tracked (**Fig. 2**), you can get a little better idea of your position, but since there are two points of intersection, you still can't be sure—it might be either. When three satellites are locked onto, however (**Fig. 3**), even though there are several points of intersection, only one is common to all three—that's your exact position! Having more than three satellites gives even better data.

Each NAVSTAR GPS satellite knows precisely where it is at all times, and where its neighboring satellites are, as well as the exact time, down to atomic accuracy. Knowing these facts, and transmitting them to your GPS receiver down on the ground, will allow the GPS receiver to calculate the time it took for the signal from each satellite to reach the receiver, and thus the distance that the various satellites are from the receiver (remembering that radio waves travel at 300,000 kilometers per second). Because the satellites are at different positions in the sky, a triangulation fix can be made on the location of the receiver, accurate to within 49 feet (15 meters). The actual location of the satellites making the fix can affect the final accuracy of the receiver's position to some degree, but that "final" accuracy can then be further improved. One way is to compare the positional data at two receiving sites that are tracking the same satellites, and then calculate (automatically) a differential that can be applied to the calculated data as a correction factor. That differential (number) can be sent over terrestrial radio and is usually referred to as DGPS (Differential GPS). It can often

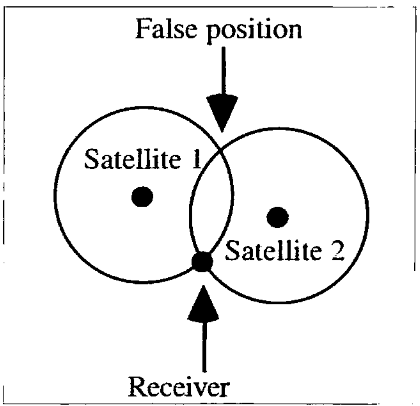


Fig. 2. With two satellites being tracked, since there are two points of intersection, you can get a better idea.

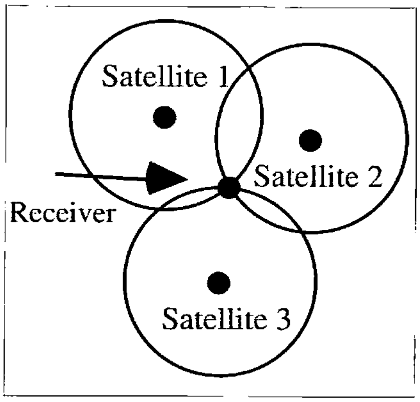


Fig. 3. Only one point of intersection is common to all three—and there you are! More than three satellites can provide even better data.

improve on the final accuracy down to an error of only 16 feet or so. Here's the second part of the equation: The U.S. military deliberately throws some inaccuracy into the GPS system available to civilian users; it's called SA and stands for "Selective Availability." U.S. military users have GPS receivers with a special code that overcomes SA, but civilian units don't, so they're automatically less accurate than their military counterparts. This gives our military a slight advantage over other (enemy) troops that might be bootlegging our satellite positioning information to use against us. The amount of SA inaccuracy introduced is controllable from a ground-based satellite command center that monitors the GPS satellite constellation. During times of troop movements or armed conflict, more SA can be introduced to make it still more difficult for the enemy to profit from our NAVSTAR system. SA inaccuracy is scheduled to be phased out over the next ten years by a law recently signed by the President. Since the SA differential can also be calculated by the means mentioned above (a second receiver site transmitting DGPS information), its value in giving our military personnel an advantage has become somewhat questionable, since the enemy knows how to get around it too, and Congress reasoned that it might as well be phased out so that higher accuracy could be made available to legitimate civilian users. Of course, GPS will also be beneficial to drug runners, smugglers and other nefarious types, but every worthwhile advancement can be abused in the hands of criminals. We can't keep technological advancements away from

the legitimate users just because there is the potential for illegal use—at least that shouldn't be the only consideration.

By the way, the NAVSTAR satellites have also been hardened (as much as is currently possible) to damage from enemy ground-based laser and particle beam attack as well as command control interception that could result in erroneous readings being transmitted from the constellation. They're also EMP (ElectroMagnetic Pulse) hardened and are designed to degrade gracefully, even if ground communication with them is lost. Aerospace design teams have to think of everything these days. The time delay in launching a replacement satellite from the ground is estimated as not exceeding two months, if and when that should prove necessary. Satellites don't last forever; high energy radiation particles from outer space, damage from small meteorites and other space debris and realistic design life of batteries and solar panels all take their toll on even the best satellite hardware.

Uses

The NAVSTAR GPS concept has tremendous potential for the recreational boater, private pilot, Civil Air Patrol volunteer, hiker, backpack camper, explorer, fisherman, climber ... and Uncle Wayne's road rally team! Anyone who strays from home can appreciate the hand-held portable GPS, just as hand-held portable transceivers are commonplace today. And of course we can't overlook the potential commercial users—commercial airliners, passenger and cargo ships, railway trains, over-the-road trucking, delivery services, etc., can all benefit from reliable positional information, and NAVSTAR GPS is it!

Then there's that APRS aspect mentioned earlier; it's a fairly recent innovation in the ham radio community, utilizing current GPS technology. It includes automatically generating packets containing exact positional data from both fixed and mobile stations. That information can then be combined with a normal amateur packet TNC, and transmitted and displayed on a map on everyone's packet computer screen. That's why many of the newer packet and multimode TNCs routinely include GPS capability within their TNC firmware these days. It's an amateur radio innovation (thanks to Bob Bruninga) that is just beginning to be explored.

But what advantage is there in having that positional information? For search and rescue efforts, parade or marathon coordination and safety watch, repeater jammer tracking, neighborhood watch patrol activities, simulated emergency tests, storm and flood assessment and assistance, recreational fox hunting and other amateur radio field activities, GPS offers the same advantages that it does to the military, recreational and commercial users: obtaining and relaying accurate positional data on and to the participating stations. If we still have that ham spirit of discovery and innovation, then it won't be long before even more innovational uses for GPS will emerge within our hobby—and *73* will publish them as they're presented.

So what's out there now?

As to what you can expect to buy right now, I'll use the features of my own (a Garmin GPS 45) in the examples, not because I'm trying to convince anyone to buy the same unit, but because it's the one I'm most familiar with. Other brands and models will have similar operating modes and features, but of course the details will vary.

I thought that my instruction manual was lacking somewhat in its guidance for beginners, especially for something as new and innovative as GPS. I would have preferred that the manufacturer had been more informative in the operator's manual, but there is an optional, well-produced instructional videotape available. The manual assumes that the operator is already familiar with the basics of navigation, waypoints and route planning. For those who aren't, a supplemental book on general navigating techniques from your local library may be worth reading first. I've always felt that tech-manual writers should make sure that they're doing the best job that they can in clarifying all of the questions the beginner might ask. I think the practical way to do this is to test the product, and the manual, by giving units to a few beginners for a week or so, along with the preliminary manual, and asking the beginners to keep accurate notes on the problem areas. A tech writer who's intimately familiar with a unit can't write a basic enough manual, one that's

completely understandable to the beginner. We see this all the time with complex ham gear manuals; not enough forethought is given to explanations that require more detail or practical examples. With modern microprocessor-based equipment, usually with multiple-function keys, a thorough manual is an absolute must!

Some initial details

The first thing you'll notice about GPS receivers: They're amazingly compact, about the size of a current dual-band talkie (my own is just 6 1/4" high by 2" wide by 1 1/4" deep). It's incredible that you can hold a true satellite tracking receiver in the palm of your hand—no dishes, no az-el steering needed. Mine operates from four internal AA batteries that will power it for 10 to 20 hours depending upon the mode chosen (normal or battery saver mode). It has a small detachable antenna (with a BNC connector on it so that an external antenna can be used) and a built-in 4-pin male socket on the back of the unit for inputting outside power (five to 40 volts DC) and ground. There's also a pin for data input and one for data output, for interfacing with a computer or to an external differential or beacon receiver. There are (or soon will be) computer-generated maps of various locations that will allow you to plot exactly where you are on a moving map of your area (or a strange area) so that, with a laptop or notebook computer, and your GPS, you'll really have to work at getting lost! All of these amenities have a price, of course, but they'll probably be within everyone's reach over the next few years if the past is any indication of the future (look at how computer prices have plummeted over the years).

For the boater, camper or hiker, many GPS receiver models are considered waterproof, often being pressurized from within, using dry nitrogen to prevent the infiltration of outside air or water. Mine is, since it was designed for the marine environment, plus it weighs a mere 10 ounces with the four AA batteries installed.

Operation

Here's the good stuff! When a GPS receiver is first powered on (or when all of its memories have been erased), it will take 7 1/2 to 15 minutes to acquire all of the satellites that it can, storing them in an almanac in its memory, and displaying its new home latitude and longitude. This auto-locate initialization is good for up to about 300 miles from home base even if the receiver is off. If you travel farther than that with the receiver off, you'll have to let it auto-locate again or you can enter the new rough latitude/longitude data manually. If you travel with the receiver turned on, or turn it on every now and then, it will re-locate itself as it goes along.

While it's auto-locating, my unit shows a nice graphical view of the sky (**Photo** A), plotting up to 8 NAVSTAR satellites on a sky map; the satellites are graphically depicted as being either on the horizon, at 45 degrees up from the horizon or overhead. The display indicates the satellite's ID number (each satellite has its own identification number), along with a relative signal strength bar for each of the satellites being tracked. This allows the user to move somewhat in various directions, or to re-orient the side-mounted antenna, to achieve the best signal reception from the constellation of satellites in view.

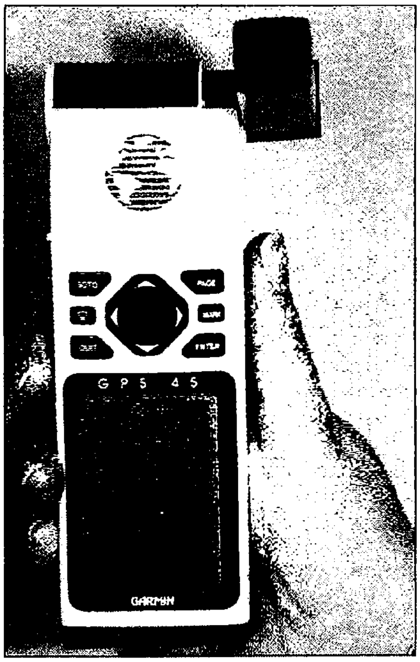


Photo A. Satellites are graphically depicted as being either on the horizon, at 45 degrees up from the horizon or overhead. The display also indicates the satellite's ID number, along with a relative signal strength bar for each of the satellites being tracked.

At least three satellites are needed to obtain a fix on your latitude and longitude; a fourth is required to give your altitude above sea-level data (providing that the unit has that 3-dimensional capability). The more satellites you can acquire at any given time, the better the positional and altitude data will be, because, again, the triangulation will be done with better geometry. I've found that it's not unusual to get good signal strength readings from six, seven or even all eight satellites in reasonably open areas, and at certain times of the day, remembering that 1.575 GHz radio waves are fairly easily absorbed or scattered by ground-based obstacles.

Once the auto-locate initialization stage is finished, and the receiver is satisfied with the data from the satellites that it can see, the page automatically changes and a moving compass dial is displayed (showing your cardinal heading anytime you're in motion; walking is good enough). It also shows a digital readout of your true bearing (a three-digit numerical display of the linear compass dial); it shows your speed of movement when in motion, and of course your latitude and longitude, out to three places, in seconds. It even tells you the accuracy of the latitude and longitude measurement as plus or minus so many feet. It automatically indicates if it's operating in the two-dimensional or three-dimensional mode and your altitude in feet above sea level when it's in the 3-D mode (with a plus or minus altitude error factor, in feet, also displayed). The exact time of day in 24-hour UTC time is displayed, or the time can be read in local time (that is, so many hours differential from UTC). Finally, the condition of the internal batteries is shown on a nice bar-graph gauge ranging from full to empty.

Stepping forward to another page, many GPS receivers will automatically map your path of travel, whether on foot or in a moving vehicle. This moving map shows every twist and turn that you might make along the way (see **Photo B**). The map (actually it's more of a where-I've-been course plot), looks something like a doodle you might have drawn on an Etch-A-Sketch™—at least that's what it reminds me of. But it's a lot more powerful than my Etch-A-Sketch ever was! When you arrive at your destination, you can follow the doodle and retrace your exact path back home. Rather than following the exact course home, you can opt to take the shortest route back instead (if you're in open country, on the open water or in the air). The map will show you the heading for that shortest course and it will display your return trip on the same map page, so that you can see immediately if you happen to stray off your mark. You can zoom in and zoom out (in 12 different steps) on the map to see every twist and turn, and you can pan across to see where various zigzags were necessary. **Photo B** shows a little doodle-map I made coming home from the store one day. It's zoomed to the 1.0 mile scale and you can see the little zigzags needed to get to my home. They're even more pronounced when zoomed into the 0.2 mile scale. My home QTH is shown in the center. The scale in miles is displayed at the top and changes as you zoom in and out. You can pan across the map to measure the exact distance from one point to another or to find those little details mentioned when you're zoomed all the way in. The map page also shows the bearing you should be taking to get back home on the return trip, the one you're actually on, the distance in miles to your destination and the speed at which you're currently moving. Everything you might possibly want to know—except perhaps where the radar speed traps are (there's other gear for that!). Incidentally, I *do* know the way back home from the store on my own, but it's a whole lot more fun this way.

"This gives our military an advantage over enemy troops that might be bootlegging our satellite positioning information to use against us."

If you decide to take the exact (retrace) course back to home base, as you might when hiking overland with natural obstacles to maneuver around, you can switch to a roadway style of display. As you can see in **Photo C**, the display looks something like a highway drawn in a perspective view, with a center line right down the middle. To retrace your exact original course, simply keep the little cursor arrow right on the center line of the roadway; you'll end up exactly where you started. There's even a finish line that appears across the roadway in case you've forgotten what home looks like.

I've mentioned only a very few of the navigational features found in a modern GPS receiver. There are a number of others. As the menu page shows in **Photo D**, you can set and store waypoints and routes, naming each one for easy recall. A waypoint is a specific location that you would like to head toward and at which something will occur. A route is a number of waypoints strung together. Putting it in understandable terms, when you drive to work each morning, you probably follow pretty much the same route. Beginning from home, you might head down Street A to Street B, making a left turn on Street B. That intersection is a waypoint. You then take Street B to Street C and turn right; that's another waypoint, a point along the way where something happens. Stringing all the waypoints in series is your route. On the open water, in the air or out in the wilderness, where streets and intersections don't exist, longitudinal and latitudinal waypoints become very important when you can't navigate by visual landmarks. They provide points of significance, where a turn or course

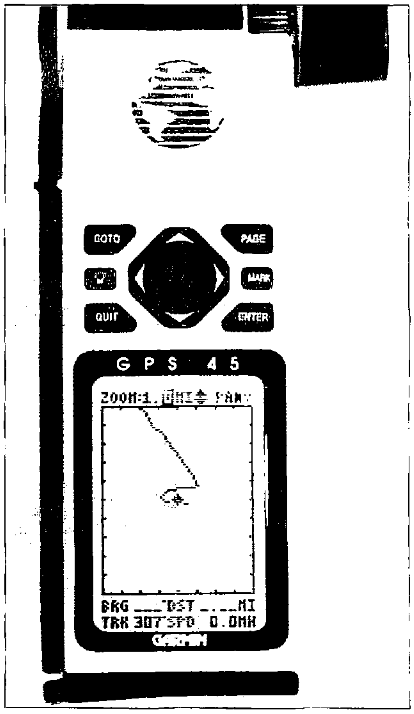


Photo B. The "Map Page" capabilities of the unit with the "moving" map readout of my trip home from the store.

change should occur, perhaps to avoid some obstacle (such as a reef while sailing). It's vital for the navigator to know when he or she has reached a waypoint, and a GPS receiver will tell you that with class. Mine will store 250 waypoints, each with its own unique name (such as HOME, FUEL, REEF, etc.). It handles 20 routes (collections of waypoints) which are reversible. If a storm suddenly comes up, there's a "nearest waypoints" page that can be called up, providing you with and guiding you to the nearest of nine safe haven waypoints (providing you've stored them in memory). There's a CDI (Course Deviation Indicator) display, an ETE (Estimated Time Enroute) display and an ETA (Estimated Time of Arrival) display at your disposal when you need them. There's a sunrise/sunset indicator that will even tell you the time of these events at the destination you're navigating toward. There are also internal messages that may be displayed from time to time: "Poor GPS Coverage" or "Accuracy Has Been Degraded" are displayed when satellite coverage is poor or non-existent.

In general, GPS receivers are meant to be used out in the open. If the 1.575 GHz signals from the satellites are blocked by buildings, mountains or even dense forest, reception will be degraded. It's still amazing that sometimes I can actually receive three or four satellites at our kitchen table—because of a large picture window facing due north.

All of these GPS functions—predetermined waypoint plotting and storage, routing information, track logs, etc., can vary from one unit to another. Some GPS receivers are aimed at certain outdoor activities or sports, such as boating. Those functions are determined by the firmware chosen by the manufacturer for a particular GPS unit, so, depending upon your own interests, you can often find a model aimed more at your own outdoor activity (I've always loved sailing). However, even a GPS aimed at the nautical crowd can be used for any general purpose navigation exercise—even just a Sunday afternoon walk through the woods. Anyone want to start an orienteering club?

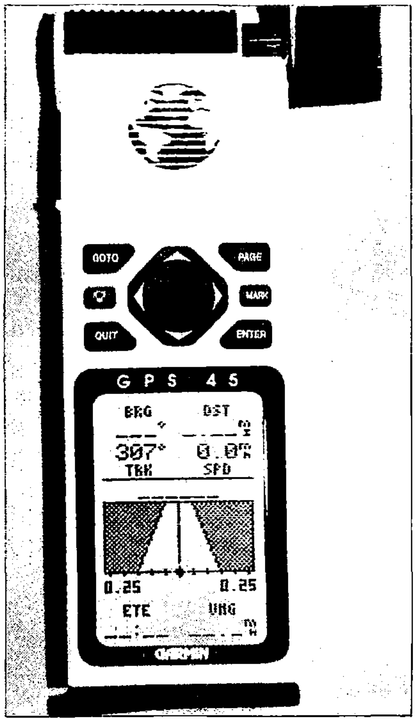


Photo C. The "Go-To-Waypoint Page" helps you to retrace your route home or to find a specific stored waypoint.

There's also a menu screen that allows the user to call up other submenus to assign the names to waypoints, enable or disable some of the functions, clear memories, define the functions (such as reading out in nautical miles as opposed to statute miles) and to access stored tracking information. You can keep a stored record of your excursions so that you can call on them in the future if you'd like to follow the exact same route, or just to revisit some enjoyable spot.

Mine even has what's called a MOB (Man OverBoard) function, which will allow you to zip back to a particular geographical spot in an emergency...say if your mother-in-law happens to fall over the transom of the boat and you hadn't noticed. Of course, it's entirely up to you if you choose to enable that MOB option or not!

A practical example

A GPS receiver in the mobile can come in very handy. My wife and I took a long-weekend motor trip into the hinterlands of Wisconsin shortly after I bought mine and installed the optional dashboard mount for the GPS-45 in our car.

Photo D. The "Menu Page" capabilities of the Garmin GPS-45 NAVSTAR satellite Global Positioning System receiver.

Even though Sue has her General Class ham license, I have the feeling that she doesn't always see the complete sanity in every electronic purchase I make. She seemed to appreciate (on the surface) the practicality of our GPS receiver, but it wasn't until we started taking some really off-the-beaten-path scenic roads that she commented, without any prompting from me, that having a GPS onboard was a nice idea. We had no fear of getting lost down those twisting, turning country roads because we knew that we could always find our way back if we ended up hopelessly lost. We saw some mighty pretty fall colors too! In fact, we spent most of the trip on those scenic back roads, and we'll do it again! The map that we had wasn't nearly detailed enough, so we followed our noses and ended up driving around one city in a large circle. We followed a route bisecting the circle and ended up where we wanted to be originally—without going all around the circle again—a first for us!

I found that just mounting the GPS up on the dash, with the windshield curvature overhead and around the sides, gave us reliable satellite coverage. The 1,100 mAh nickel metal hydride AA cells that I'm using in the GPS-45 will power it for a full day's driving on the battery-saver mode and I simply recharged them overnight in our lodgings. It's nice to have an accurate compass onboard too (one that doesn't dance around), and I discovered that the car's speedometer is actually three miles per hour slower than true. But just having an accurate map of where we had been, and knowing that we could always get back again, was very comforting, and as Sue put it, a nice idea. In unfamiliar territory, it only takes one wrong turn to become disoriented; but with your GPS receiver, you can find your way back easily.

As an aside, I did notice some RFI in our 2-meter mobile transceiver, on certain frequencies, attributable to the GPS receiver's oscillators. The solution was to avoid those frequencies, but it was somewhat surprising. I've not tried to work out another solution yet; the problem isn't serious for us since it doesn't affect the channels we're most interested in monitoring. There may be conflicts like this on other bands as well; I've not checked them, but don't be too surprised if you find some birdies somewhere.

Other interesting asides

GPS technology has a number of diverse potential uses for the future. It can be used for tracking endangered species, with exact positional data always available on the monitored animals, as well as auto-mapping of a particular animal's recent roam-area. GPS has seen duty on high altitude balloon flights investigating the much publicized ozone layer depletion studies and it was used to record the undersea resting position of the famed passenger ship *Titanic*. It can be used in forestry and geological survey studies, accurately mapping the boundaries of areas of natural resources as well as in locating and documenting small villages and remote population concentrations in obscure parts of the world. Since one of the side benefits of GPS is high accuracy time keeping, anyone who needs that advantage (radio amateurs included) can benefit from this important aspect of the orbiting satellite PVT (Position-Velocity-Time) technology. Mapping flood- or hurricane-ravaged areas anywhere in the world by air and helping to deploy and direct firefighters to forest fires also requires accurate positional data, in the air and on the ground; GPS answers those needs. There's progress being made to use GPS as an aid to the blind, which is yet another reason for doing away with the intentional inaccuracy of SA (discussed earlier). Coupled with a voice synthesizer, the waypoint and routing features of a GPS receiver can potentially be used to prompt blind people to reach a predetermined goal.

The Russians are coming!

Orbital placement of a second constellation of global positioning satellites has been underway for several years now, initiated by Russia. It was begun before the breakup of the Soviet Union and goes under the name GLONASS. When fully operational, GLONASS also promises to provide position, velocity and time information to users worldwide (most current GPS receivers will probably not be usable with the Russian system, though the frequencies used are relatively close—GLONASS is said to be just above 1.6 GHz).

As you can see, the average GPS receiver is versatile, affordable, and works by reading the data from orbiting satellites 10,900 miles or more away ... all in the palm of your hand. To me, that's pretty exciting. What do *you* think?

Communications & Live ATV Via Outer Space

Some real-life use of the ham satellites.

Farrell Winder W8ZCF
6686 Hitching Post Lane
Cincinnati OH 45230
E-mail: fwinder @one.net

Dr. Don Miller W9NTP
8339 South, 850 West
Waldron IN 46182
E-mail: w9ntpdon@ind.tds.net

During the 1996 Dayton HamVention, a short movie was discovered running at the AMSAT booth. This movie showed two amateur stations involved in a Q5 QSO utilizing the AO-27 satellite.

Several months earlier, W8ZCF and his son, KB8VCO, had been trying to come up with a plan for communicating while KB8VCO was on vacation with his family in Juarez, Mexico and El Paso, Texas. They considered several of the HF bands, but decided that unless enough power and suitable antennas could be set up by KB8VCO on a portable basis, that such an arrangement didn't seem feasible, at least on a consistent basis.

Photo A. KB8VCO's equipment for AO-27 voice contact (photo by Vicky Winder).

The AMSAT movie raised the possibility of using AO-27 for the communications link. Tests were made just before the trip to Juarez; KB8VCO used a Yaesu FT 530 dual-band HT which provided about two watts output on two meters, along with 70 cm reception. The antenna was a Cushcraft A270-6S, consisting of a pair of three element yagis on a single mast for transmitting on the two meter uplink frequency and receiving on the 70 cm downlink frequency. It was used as a handheld antenna and manually pointed towards the satellite. **Photos A** and **B** show KB8VCO's setup. A tracking program was used for initial antenna orientation with signal strength indication from the satellite to maintain tracking.

"Those pictures were sent over 2,000 miles round trip using 1/2 watt on 70cm!"

Upon arrival in Juarez, and for a period of more than two weeks, contacts were made on a daily basis from the Juarez/El Paso area to and from Cincinnati, Ohio. During the return trip, contacts were continued from Texas and Arkansas. Those contacts were so successful that an idea emerged for an experiment while W9NTP and W8ZCF were in contact during regular early-morning ATV exchanges between Waldron, Indiana and Cincinnati, Ohio. The idea was to try sending a live picture via AO-27.

Initial experiments were encouraging. On the third attempt, complete pictures were sent and received by both W9NTP and W8ZCF. Photographs of these pictures are shown in **Photo C** and **Photo D**—remarkable, considering the very low output power of the AO-27 which is only 1/2 watt on 70 cm! This microsat satellite is a cube-shaped package approximately 5.9 inches on a side and in a nearly circular polar orbit at about 500 miles above the Earth. The actual distance covered in transmission to and from the satellite to create these pictures was over 2,000 miles, round trip!

The uplink frequency for AO-27 is 145.850 MHz and the downlink is 436.800 MHz. Approximately 20 kHz of Doppler was observed over the longest AOS to LOS footprints. W9NTP's setup used an OSCAR circular polarized antenna for 2 meters. A

Photo B. KB8VCO tracking AO-27 (photo by W8ZCF).

vertically polarized FO-22 (22 element yagi) antenna, (with az-el rotators) feeding a KP-1 preamp into an ICOM R7000, was used for receiving 70 cm. A Robot 1200C Color TV Scan Converter was used to process the video sent to and from W8ZCF. A Yaesu FT 736 was used to transmit video on two meters to the satellite.

W8ZCF's setup used the basic antenna setup used regularly every morning for "earthbound" ATV contacts. This consists of a Cushcraft 13B2 (13 element) yagi, vertically polarized antenna on two meters and a Rutland FO 22 (22 element) horizontally polarized yagi for 70 cm. The FO 22 fed a KP-1 preamp to an FT 736R for 70 cm receiving. A Tasco TSC-70U SSTV Scan Converter was used to process the sending and receiving of pictures to and from W9NTP. The transmission mode used by both stations was Robot 36 Color.

Over the course of this experiment, several local stations became interested and engaged in voice contacts on AO-27. Dick Goode W8RVH, in New Carlisle, Ohio, did an analysis with a 7 element home-brew yagi for the 70 cm signal from the satellite. He discovered that the satellite transmitting antenna consistently enters the descending pass with vertical polarization and rotates to a nearly horizontal polarization during the completion of the pass. W8ZCF's FO 22 horizontally polarized antenna without an elevation rotor therefore gave best performance at low (under 5°) elevations which occurred during the latter part of the westernmost passes. Signal strength on the lower part of these western passes often yielded readings of S9 +10 to 20 dB.

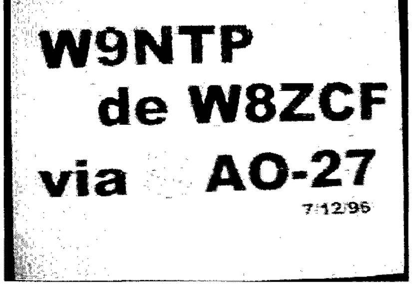


Photo C. Picture received by W9NTP using a Robot 1200C Converter (Mode: Robot 36 Color).

"This satellite provides pleasure and experimentation to many."

W8ZCF used the STSORBIT PLUS Tracking Software Program written by David Ransom, Rancho Palos Verdes, CA. The initial position of the satellite during the start of the video transmission of the picture to W9NTP is shown in Photo E (the STSORBIT graphic presentation). W9NTP used the Instant Track satellite tracking program.

The picture received by W9NTP is regarded as almost a "perfect picture." A partial single horizontal noise line appeared in the original picture just above the W9 portion of the call letters. This was corrected by using the "Fix Glitch" feature of the HIRES-70 program developed by Tom Jenkins N9AMR of Indianapolis for use with the TASCO TSC-70 Scan Converter. The picture (**Photo C**) received originally by W9NTP was later retransmitted to W8ZCF from Waldron, Indiana and photographed from a 14-inch TV Screen using a Pentax ME Super Camera with 1/4 sec. exposure. **Photo D**, received direct by W8ZCF, was photographed using the same TV/camera setup.

Photo D. W9NTP's picture as received by W8ZCF using a TASCO TSC-70 (Mode: Robot 36 Color).

This project proved to be challenging, fun and rewarding to the parties involved. Several bystanders also followed this experiment—and as a result, a number of new satellite communicators have emerged. All of these operators may now be better prepared to utilize the future multimode satellites, such as Phase 3D, that are in progress.

Thanks go to the many innovative engineering designers and developers who have made the AO-27 satellite with its performance capabilities possible. Obviously, this satellite provides a great deal of pleasure and experimentation to many amateur radio operators. 73

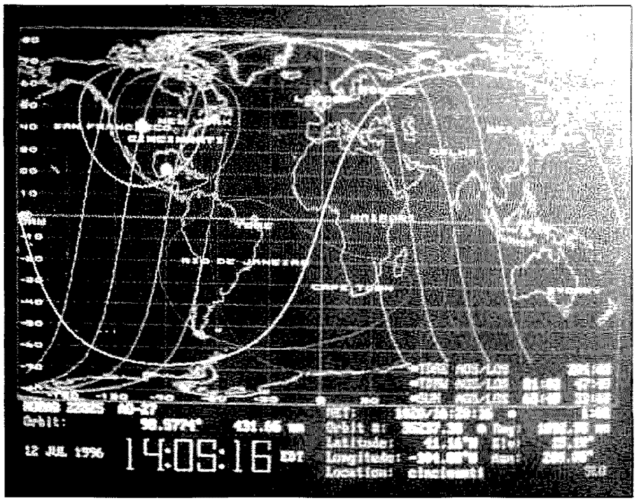


Photo E. STSORBIT tracking presentation of AO-27 (photo by W8ZCF).

Satellite Tracking With Style

Nova for Windows©

Andrew Skattebo KAØSNL
P.O. Box 241
Knoxville IL 61448-0241

Every once in a while a piece of software comes along that makes me glad I own a computer, or might prompt me to buy one if I didn't. Nova for Windows© is just such a program. This full-featured satellite tracking program from Northern Lights Software is not only useful to diehard satellite enthusiasts and EME operators, but is also a fantastic educational tool for anyone interested in satellites and space activities in general.

This program, written by Dr. Michael Owen W9IP and Dr. C.J. Knickerbocker, is a giant leap forward in quality and capability over most other current Windows tracking programs. The fact that you've got something new and different is boldly obvious as you look at the opening screen. Displayed is a gorgeous full-color map of the Earth with a constellation of satellites whizzing around it. This color map is different from other, cartoonish displays, since it is actually a composite satellite photograph of Earth, showing the varied terrain—including mountains, rivers, deserts and even snow in the extreme northern and southern hemispheres.

This display is also customizable to your heart's content. You may choose between a flat map of the Earth with the satellite footprints projected on it, or a 3D space view with footprints. There is an *incredible* 3D view with the orbits for each satellite shown and labeled. This view is a great learning tool for beginning satellite operators or for student education. It allows you to visualize the satellite in orbit and helps make sense out of those abstract numbers (Keplerian elements) used for satellite tracking.

In addition to the basic screens there are a couple of unique views that are harder to visualize until you actually use the program. First is the radar view which gives you a radar screen image with satellites plotted in an azimuth-and-elevation display, showing their paths across the sky from your location. Also available is the sky view, mainly of interest to moonbounce operators, which plots a selected satellite (or the moon) on a map of the sky showing the natural background noise sources such as the center of our galaxy. Not only can Nova for Windows track satellites but also the sun, moon, planets and a handful of other celestial bodies. The overwhelming thing about all of these views is that you can have them onscreen one at a time, or in any combination, even all at once. The program has no limit to the number of satellites you can track or display views you can have running simultaneously. You can track to the limits of your computer capability and display readability.

Besides the flashy new displays and functions, the program has a solid base of features, as we've come to expect from satellite software. A printed table of upcoming passes for a satellite, two-observer mutual windows, squint angle information and two-satellite mutual visibility are only some of the basic features. A quick visibility check feature allows you to see at a glance which satellites are above your horizon at the present time. Of course, automatic antenna tracking is also supported for those of you using the Kansas City Tracker, SASI Sat-Tracker or AEA's ST-1 rotor control interfaces. These are just a few of the functions available—there are simply too many to list!

Even though there are dozens of features and new capabilities, the program's operation is pretty straightforward. The software takes advantage of the standard Windows user interface so it has a familiar look and feel. Some users may wish for a user's manual or more extensive on-line help files, since there is no manual and help files are absent from some screens. However, a little time spent exploring the program will have you operating comfortably in a short

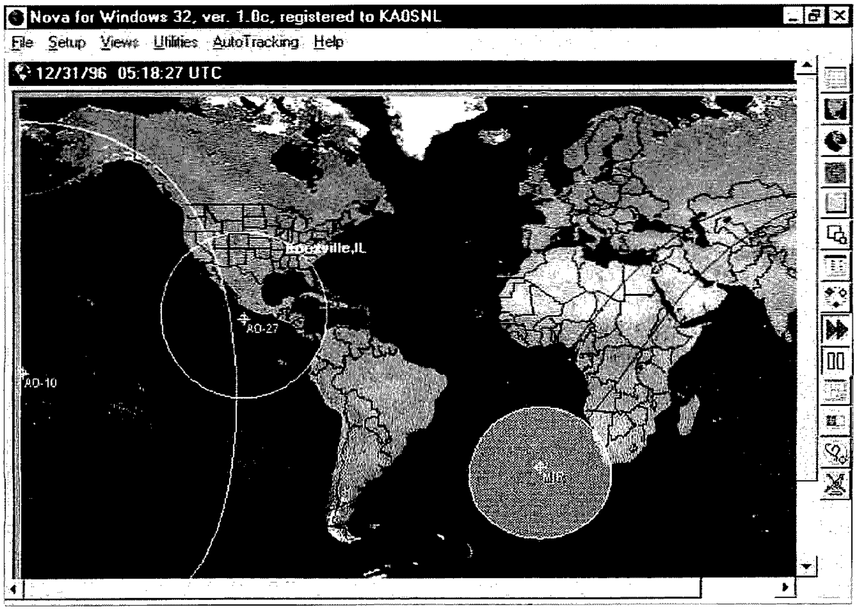


Fig. 1. Map from Nova showing footprints of AO-10, AO-27, and Mir.

time. Many of the commonly used features are available on a toolbar. This toolbar allows changing displays, and accessing some of the setup options from a simple point-and-click interface. Functions such as modifying the observer database, and updating the satellite element files, that are not reachable from the toolbar, are accessed from a menu at the top of the screen or by right-clicking on a particular item.

Nova for Windows allows most users to get up and running quickly. There are only a few things to accomplish to make the program immediately useful, and a quick tip sheet (included with the program) provides basic information to get you started. After completing installation, make sure your station location is in the observer list. Go to the menu at the top of the screen, click on "setup," then "observers." Find your city from the right side main database and drag it to the left observer database. If your city is not listed you must manually enter the coordinates in the lower left panel, enter the location name and save it as a new observer site.

Also, to ensure that you have up-to-date Keplerian elements you will need to update that file with the most current set. Get your keps from your usual source and save the text file in the Data folder of Nova's directory. To update Nova go to the menu at the top of the screen. Click "setup," then "satellites." This brings you to the satellite editor screen. Now click "update," and find the file you want to use for the update. Select "open" and your file is automatically updated. Simple as that.

To configure your tracking screen or create additional views, you can right-click on the map screen or use the button on the toolbar. In either case select "configure current view"; this takes you to the individual view configuration screen. Simply drag and drop observers and satellites from the respective lists. Select a map display option and right-click to customize that map to your needs. When you're done click on the new button and type in a name for this view. Select "OK" and you're set. You can create as many configurations as you like for different situations. For instance, I have one for the microsats, one for high-orbit birds and another with the shuttle and *Mir* only, for use during Sarex missions.

Nova for Windows is available in both 16-bit Windows and 32-bit Win 95 versions. The programs are nearly identical. The 32-bit version for Windows 95 does take advantage of Win 95's multithreading and multitasking features for smoother operation when autotracking. Additionally, new add-ons such as Nova FTP and Nova GPS are designed to use the 32-bit Win 95 version. Nova FTP automates the process of updating

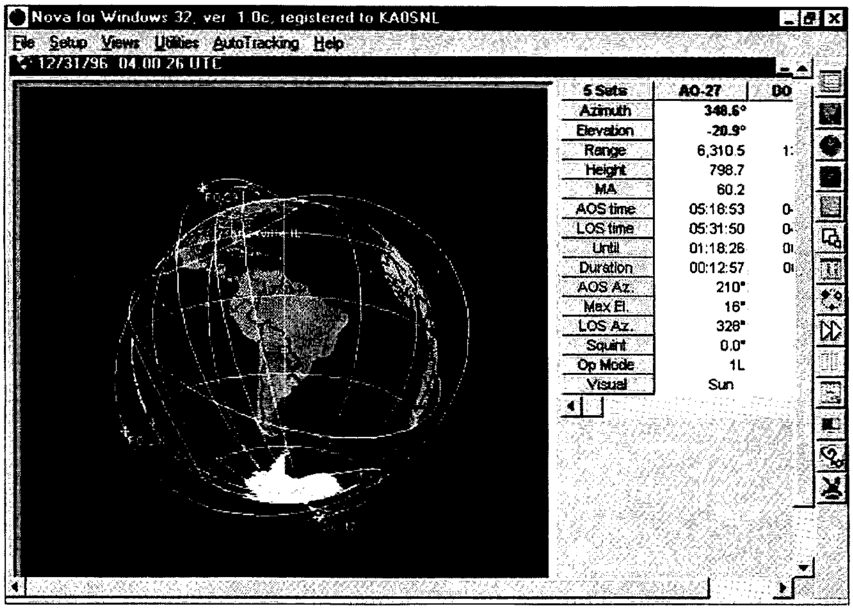


Fig. 2. Space view from Nova showing multiple satellites and their orbits.

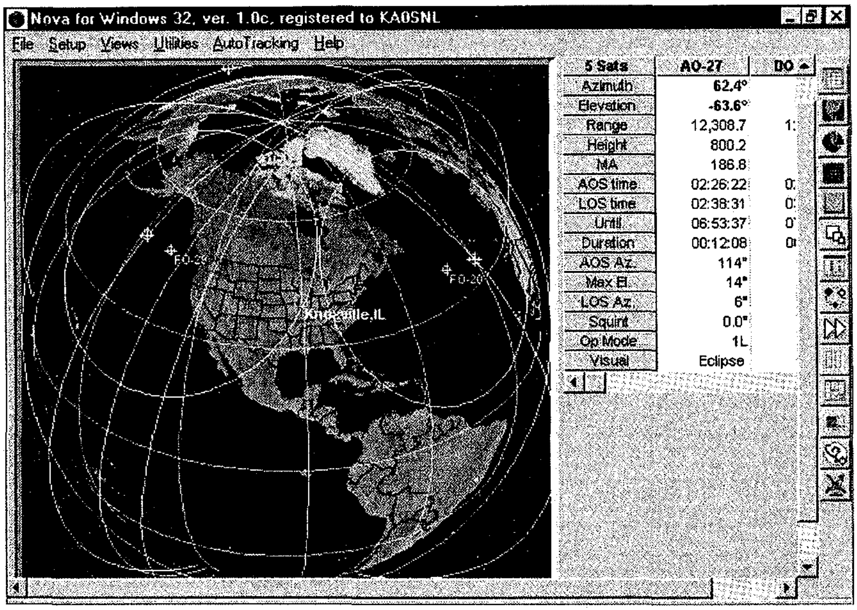


Fig. 3. Nova screen capture showing the space with orbit view and satelite footprints.

Keplerian elements and Nova GPS reads information from a portable GPS receiver and updates station time and location information. Contact Northern Lights or visit the Web site for the latest information. I have both versions of the program, running on a 120 MHz Pentium™ with 16 MB of RAM and the Novawin folder occupies approximately 13 MB of space on my hard drive. However, the minimum system requirements call for at least a 386 with coprocessor, 10 MB of hard disk space and a VGA display with 256 colors or more.

I still sit amazed as I watch the microsat satellites marching in order, coming up over the pole in almost single file, their orbits displayed along with their footprints, all being tracked at once, in real-time. I have seen nothing like it before and friends, even non-hams are enthralled at the display quality. It has become a favorite demo to show off the computer to visitors and I can see its usefulness in education as well. This program is a must-have for anyone interested in satellites, moonbounce and other space-related activities.

Nova for Windows is available from AMSAT for a donation of $50 for members and $60 for non-members. Currently only the 16-bit version is available through AMSAT but you can easily upgrade by going to the Nova Web site and downloading the 32-bit upgrade. A portion of the proceeds will go to benefit the amateur space program, so your money does double duty. You get a great piece of software and the amateur space program gets your support.

To order, contact:
AMSAT
850 Sligo Avenue Suite 600
Silver Spring MD 20910
Ph. 301-589-6062

For more information, contact:
Northern Lights Software
2881 CR 21
Canton NY 13617
Nova for Windows (16- or 32-bit) $59.95ppd
E-mail: nlsa@northnet.org
Internet: www.webcom.com/w9ip

An E-mail mailing list for Nova is also available; check Web site for details. 73

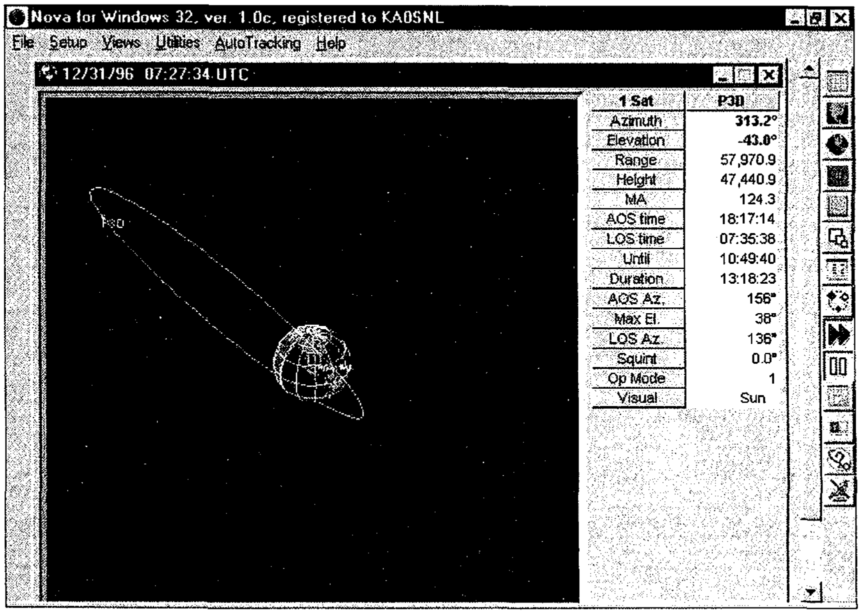


Fig. 4. The proposed orbit of the soon-to-be-launched P3D spacecraft.

A 500-Foot Antenna?

Going to new heights in Maryland.

Joe Nunemaker KD3VR
9303 Calanda Street
Lanham MD 20706

John asked, "What kind of signal would you get with a 500-foot antenna?"

"A great one," I said.

"Hmmm," he said, pondering the idea. "How would you support a 500-foot antenna?"

I considered for a moment. "A balloon would do nicely," I said.

"Do you think a kite could take up 500 feet of wire?" he asked.

John Williams N5SJZ called me a few days later with some exciting information. He had visited a kite store where he had researched a number of kites and their flying abilities. I drove to his home to see his space-age kite and listen to him describe its performance characteristics. The kite was made of rip-stop nylon, shaped in a combination delta and box form. This type of kite is specifically designed for stability and strong lifting ability in high winds. I agreed we should give it a shot, so we made plans to try it out as soon as possible.

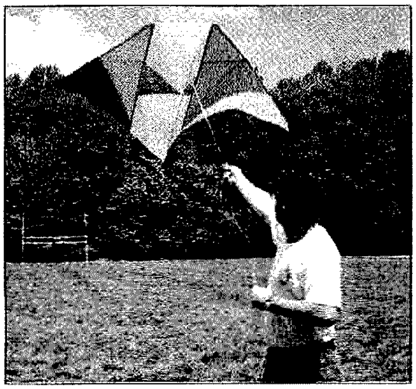


Photo A. John Williams N5SJZ launching the 500-foot antenna.

We put together a nice portable station and waited for a good day. Our station consisted of my TS440S, an antenna tuner designed to load a longwire, a four-foot copper ground stake, an antenna insulator, a fishing swivel to prevent twists in the wire, and assorted hardware to connect everything together.

"Do you think a kite could take up 500 feet of wire?"

We looked at various types of wire. We thought 500 feet of copper wire (even 20 gauge) would be too heavy, so we looked around to see what else was available. Aluminum electric fence wire was light, cheap, and readily available in 500-foot rolls. A good solution.

During the course of our on-the-air discussions we were joined by Glenn Garnes N3UCE, who wanted to participate in our adventure—and let's not forget John's wife, Debby N5SKA.

Photo B. Glenn Garnes N3UCE, Joe Nunemaker KD3VR (back), Debbie Williams N5SKA, John Williams N5SJZ (front), working the pileups.

Did it work?

It was not long before we had a perfect weekend afternoon—sunny, windy and warm. What more could we ask for?

We found a great location for our adventure—the US Naval Academy in Annapolis. The Academy has a large field area right next to Chesapeake Bay, with no power lines anywhere around. We set up the kite in a few minutes and it hauled our antenna up without a hitch. The signals were so strong we had to use the radio's attenuator.

> ***"The signals were so strong we had to use the radio's attenuator."***

Our CQs resulted in some nice contacts, and within an hour we had a waiting list. In order for everyone to operate on HF, I was the control operator and we worked under my call for the day. Working 80 meters. we covered mainly the eastern half of the U.S., along with several stations from Canada. Signal reports were 5/7 or above. The antenna and its mount were the topic of the day!

It was an exciting day and we plan to do it again soon. After our outing Glenn N3UCE visited a kite store and bought a 14-foot kite that I'll bet could lift a small child. We're planning to send up 1,000 feet of antenna wire with that kite. Listen up for us. Better yet, buy a kite and join the fun! 73s.

Photos by Glenn Garnes N3UCE and Debby Williams N5SKA.

[Editor's Note: This article originally appeared in *Green Mountain News,* official newsletter of the Green Mountain Repeater Association, Inc. Spring/Summer 1996 edition.]

Photo C. The rig and antenna tuner. Yep, that's all it took to have a fantastic time—plus the kite, 500 feet of wire, and a breeze.

KC2 Multi-Function Transceiver Accessory

The tiny kit that does it all!

Robert S. Capon W3DX
(formerly WA3ULH)
107 Cavalier Drive
Charlottesville VA 22901

If membership in the three-year-old Northern California QRP Club (NorCal) can be used as an indicator, interest in QRP kit-building is making a strong comeback. This year, NorCal membership quietly zoomed past 2,000 members.

One of the key reasons for this enthusiasm in NorCal is the series of innovative QRP kits designed by Wayne Burdick N6KR, made available to club members by NorCal and to the general public by Wilderness Radio. These kits have included the NorCal 40, a 40-meter transceiver that draws only 17 mA, and the Sierra, a multi-band QRP transceiver with band modules, featured on the cover of the *1996 ARRL Handbook*.

Wayne's latest kit is the KC2, a unique multi-function transceiver accessory. The KC2 combines a memory keyer, 4-digit LCD frequency counter, bar-graph S-meter, and a digital wattmeter in a package that draws a meager 7 mA and measures 1.1" x 2.9" x 0.8". This combination makes the KC2 an ideal accessory for QRP transceivers.

Three KC2 innovations

The KC2 employs a number of innovations to address the common problems traditionally associated with QRP frequency counters: size, current consumption, and noise.

To achieve its small size, the KC2 uses two printed circuit boards that are stacked like a sandwich, and held together by nylon nuts, bolts and spacers. Further, the two largest components are mounted piggyback.

To reduce current consumption, N6KR employs carefully chosen power efficient CMOS components, and uses an LCD display. The KC2's current consumption of only 7 mA compares to 100-200 mA for comparable frequency counters. As a result, my Sierra QRP transceiver draws a total of only 40 mA, including the KC2 frequency counter and keyer!

Perhaps the most novel innovation employed within the KC2 is in the area of noise reduction. Most frequency counters must be mounted in an external enclosure because of microprocessor noise leaking into the radio's receiver. N6KR discovered that he could eliminate noise by running the KC2's 4-MHz microprocessor at a sluggish 100 kHz. As a result, the KC2 can be mounted inside a transceiver without the need for any special shielding.

> ***"My Sierra QRP transceiver draws a total of only 40 mA, including the KC2 frequency counter and keyer!"***

Frequency counter

The KC2 display default is the frequency counter. The counter is a four-digit LCD display with 0.1-kHz resolution. The display numerals are approximately 0.35-inch in height. A hysteresis technique is used to eliminate flicker of the last digit.

The counter will read VFOs in the range of 300 kHz to 6,400 MHz, making the KC2 usable for most QRP rigs. But be sure to check the user's guide on your QRP rig to make sure that the VFO falls within this range.

The KC2 features four programmable offsets stored in nonvolatile memory to work with multiband, multi-offset radios. This should prove to be overkill for most QRP rigs. The Sierra eight band radio has the most complex assortment of VFO offsets (three) of any rig in my collection. The Oak Hills OHR-400 four-band rig uses the same offset for all four bands.

Programming the KC2 is a snap! To program it, you set your rig to a convenient frequency as measured by your main station transceiver, scroll the KC2 display to match the frequency, and exit set-up mode to accept the frequency. That's it.

Keyer

The KC2 is a respectable memory keyer, but lacks the dazzling array of keying features (like automatic sequencing of serial numbers) found in the CMOS Logikeyer III, which is still my favorite high performance memory keyer.

However, the KC2 does include a 50-character keyer memory with a useful repeat word function and multiple memory partitions. Keyer memories are stored in nonvolatile memory; however, memories do not have separate buttons for each partition. For example, to access memory partition number three, the user presses the keyer button three times.

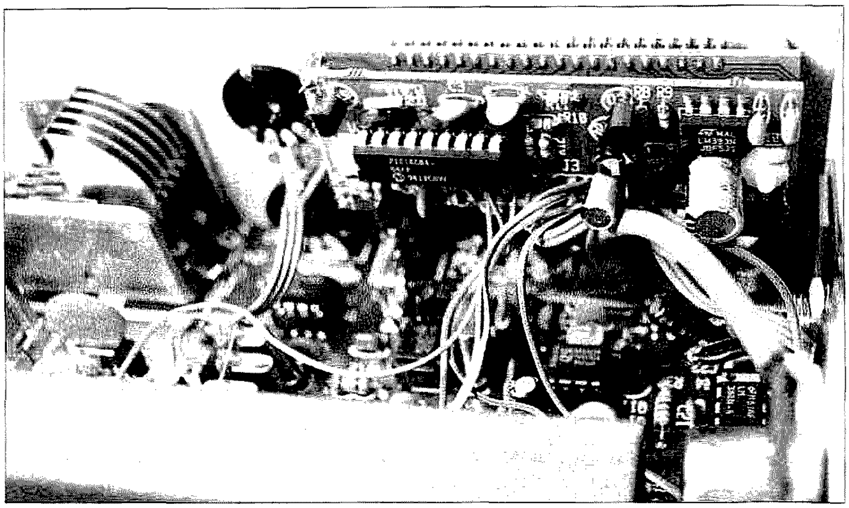


Photo A*. The KC2 installed in the Sierra. The board measures only 1.1" x 2.9" x 0.8".*

Other KC2 features include emulation for Curtis mode A, CMOS Super Keyer II, and Curtis mode B. The speed range is eight to 50 WPM in two-WPM steps using push-buttons supplied with the kit, rather than a knob. The KC2 also features a weight control with eight selectable keying weight levels.

S-meter

The KC2 includes a nifty S-meter bar graph, along with built-in S-meter circuitry. To access the S-meter, the user pushes a button to toggle between the S-meter and the frequency counter.

The input requirements are an audio signal, in the range of DC to 20 kHz, with any rig that uses audio-derived AGC.

Wattmeter

The KC2 also includes a digital RF wattmeter that measures power in the range of zero to 9.9 W in 0.1-watt increments. To access the wattmeter, the user presses the Speed-up and Speed-down push-buttons at the same time, which holds the key-down in a tune function, and measures the power.

The wattmeter is a little more difficult to use with rigs other than the Sierra, because the builder has to put together a small RF detector circuit with five components (these components are already built into the Sierra).

Construction

The kit comes with only 51 components, and can be assembled in one to two hours by an experienced builder. Interfacing it to your QRP kit is very easy, because you have only a few inputs: 12 Volts, ground, dot, dash, VFO, key, S-meter, RF power.

Mounting the KC2 is also very easy. The unit has four momentary SPST switches that mount on the board, and are used to mount the unit behind the front panel of your rig. The user's guide includes a handy template to locate the mounting holes, which are very easy to locate and to drill. The rectangular opening is much trickier. I cut the rectangle by using a Radio Shack™ nibbling tool to nibble the approximate opening, and care-fully filed the opening to the exact dimensions.

As of the writing of this article, Wilderness Radio was gathering user comments from many of the popular QRP kits, and furnishing interface instructions with the kit. Wilderness Radio has also developed an optional front panel for the Sierra, which is custom punched and silk-screened for the KC2.

On the air

On the air, the KC2 is a pleasure to use. It's really fun to operate my QRP rigs with digital readout. I've especially enjoyed using the RIT feature in my Sierra with digital readout to work split frequency QRP DX with more precision.

The KC2's unique combination of memory keyer, 4-digit LCD frequency counter, bar-graph S-meter, and a digital wattmeter makes it the ideal multi-function transceiver accessory for most QRP rigs. Its low power consumption and small size mean that it can fit in a very small enclosure, bringing the power of digital frequency readout and a memory keyer to field applications like back-packing trips and Field Day.

For more information, contact Northern California QRP Club (NorCal), c/o Jim Cates WA6GER, 3241 Eastwood Road, Sacramento CA 95821, (916) 487-3580. To order ($75 plus $3 shipping & handling), contact Wilderness Radio, P.O. Box 734, Los Altos CA 94023-0734, (415) 494-3806.

Photo B*. The author's highly modified Sierra and Oak Hills Research OHR-100 with KC2.*

ARRL Code Survey

Should code be kept as a license requirement?

Alex Haynes AC5HU
Rt. 2, Box 87-C
Eureka Springs AR 72632

It might be news to many of you who are not members of the ARRL, but they are doing an opinion survey about keeping the fast code requirement for earning a ham license.

It may just be my dislike of code showing through, but it seems to me we are long overdue in reassessing the demand that fast code be a requirement for a U.S. amateur radio license.

While code was a necessity for communication in the very early days of radio, it was overtaken long ago by superior technology. And although it is a wonderfully nostalgic way to communicate, in this day and age there is no longer a technical justification for requiring a code proficiency for an amateur license. Sure, I've heard all the arguments over the last 50 years. Some used to make sense, some never did, and a few shouldn't even be mentioned in polite company—so let's leave those until last.

As I understand it, the most important reason code came into use in the early days of electrical communication was the compatibility with the needs of a simple wire-type telegraph system. An on-off signal was the only way to send information, and it worked well. Along came radio and simply turning the carrier wave on and off became the accepted way of transmitting intelligence, just as it had on the telegraph system. Soon, equipment was developed to modulate the RF carrier with sound and AM radio was born. Then FM, single sideband, digital encoding and many other ways were developed to impress intelligence on an RF carrier. My point is, there are many different ways of electronically transferring intelligence and each has its own advantages and disadvantages. Why then should one of them be singled out as the *only* one necessary to master, at a specific speed yet, in order to obtain an amateur license? Code isn't even a technology; it's a psychomotor skill. Thank goodness we don't have an ARRL-like organization controlling our computer hobby, for we all might have to prove we could type 20 wpm on a mechanical computer just because "that's the way Babbage did it." Maybe it's time for the ARRL to adopt a new name more in fitting with their quaint position on code—how about the Antique Radio Relay League? A bit harsh? Perhaps, but at least it would clear the way for a new organization that could speak from a wider perspective, reflecting the views of the vast majority of hams who have chosen not to join the ARRL.

"Maybe it's time for the ARRL to adopt a new name more in fitting with their quaint position on code—how about the Antique Radio Relay League?"

But let's try to understand the logic for keeping a code requirement for ham radio. One claim is that it's a more efficient use of radio spectrum. Something like a 500-Hz bandwidth compared to a 2.5-kHz for SSB. True enough, but since people talk 5 to 10 times faster than they can send code, the real-time bandwidth requirement is comparable for both code and phone. And for digital transmissions, the efficiency of data transfer is many times that of manual CW or phone. But the real hypocrisy of this CW efficiency claim becomes obvious by simply looking at the portions of the 15, 20, 40 and 80 meter bands the code advocates have set aside for themselves. Of course those frequencies are shared with RTTY/DATA, but certainly a "more efficient mode" should not require half of the available spectrum.

Well then, how about communication range: CW is much better, right? Sure, you can often get through with code when you can't on phone and if DXing is your bag, then use the best way available (including digital packet, spread spectrum or whatever) if you want. But why should this justify requiring a code proficiency in order to be granted an amateur license? Why should we even want to force a particular mode of communication on hams? In a free marketplace of ideas, if CW is the best way, wouldn't it come out on top anyway?

All right then, how about "national emergency" communications? Isn't that one of the main justifications for allocating RF spectrum to the Amateur Radio Service? That may have been an

important consideration at one time—long ago. But even our Armed Forces, the Coast Guard and ships at sea have decided to drop code. About the only other people you could communicate with using code would be other hams. Besides, wouldn't the larger number of hams entering the hobby in the absence of a code barrier be a much greater communications asset in an emergency?

Let's face it, for communicating on the go, ham radio has been left in the dust. Most people who want to communicate from cars use cellular telephones. This ought to suggest something to us about where ham radio is headed and just how secure our current frequency allocations might be in the future. Either we increase the size of our lobby or we risk losing our hobby.

How about international treaty requirements? Well, yes, there is an international requirement to send and receive code manually—but there is no speed requirement. The 5, 13 and 20 wpm requirements are arbitrary (and capricious, I believe). They are being forced on the amateur community by a small minority of old fogies in the ARRL and a few dupes at the FCC. The main effect of the code requirement is to reduce the number of licensed amateurs in the U.S.

And now comes the time to discuss what we shouldn't have to discuss. I'd hate to count the times I have heard the sentiment "I had to learn code and so should every one else who wants to be a ham—besides, it cuts down clutter on the bands." A shameful attitude, to say the least. And, of course, readily denied on every official level. Look, the ARRL will say, we sponsor an extensive amateur licensing program intended to increase our ranks. But who, nowadays, really doesn't understand the concepts of hidden agendas, countervailing policies and just plain old-fashioned doublethink? It strikes me that many hams have abandoned most intellectual arguments for code, but still cling to this selfish "I got mine the hard way and so should you" attitude. Many bright young potential hams reject the notion of being forced to master a skill they see as irrelevant—they just don't have time for this nonsense.

Without this unnecessary barrier, how many more hams could we have had by now to build, experiment, innovate, manufacture and buy equipment? Take a look at all the domestic parts and equipment manufacturers that have folded over the last several decades. Then look at some of the Asian countries with minimal code requirements and large ham communities—the ones that produce most all of our new ham equipment.

I certainly don't want to leave the impression I am totally anti-ARRL, because I am not. But it just seems so obvious the ARRL is on the wrong side of the code issue, and they have been for so long, it is difficult to give them the credit they deserve for all the other good they do.

The ARRL's intransigence on the code requirement has caused the unfair exclusion of a significant portion of the public from equitable access to a public resource, and for this the ARRL should be held accountable; it is why I dropped my ARRL membership more than 20 years ago. For this and a variety of other reasons many hams refuse to support the ARRL (only about a quarter of all licensed hams are members) and their claim to represent a consensus of opinion among hams needs to be closely scrutinized. We should not forget the ARRL is a *private* organization and is answerable only to its members, virtually all of whom are licensed amateur radio operators. So how is the voice of the rest of the American public and the other 75% of hams represented in this equation? Well, supposedly through the FCC. But wait a minute, who does the FCC depend on to advise them in setting public policy for amateur radio? Who else but the ARRL?

"A 'more efficient mode' should not require half of the available spectrum."

Most hams (and non-hams) have very little direct voice in setting public policy for amateur radio, except for the occasional congressman who might take an interest in a specific issue (but who probably is also a ham) or a manufacturer with a proprietary interest. So, because of this typical incestuous relationship in which the "public regulator" (in this instance the FCC) becomes a pawn of the supposed "regulatee" (amateur radio special interests), many aspects of public interest issues are never fully explored. If code is so important, why is there no requirement for periodic testing to prove continued proficiency? After all, high speed code is a skill of the use-it-or-lose-it type. It is not the kind of logical intelligence that is learned once and retained for a long time. Fast code must be routinely exercised or is rapidly lost. And this leads to perhaps our dirtiest little secret.

My guess would be that at least half of U.S. amateurs (probably far more) currently are unable to copy code at the speed required by their license class. I doubt the ARRL could prove otherwise. I would go even further and claim most hams don't use any code at all and have lost virtually all ability to send and receive code. So, are we in violation of the intent of "international treaty"? Does it matter? Does anyone care?

Surely the FCC must know the vast majority of licensed hams can't effectively communicate using code. So how can our government continue to bend to the hypocritical demands of the ARRL? The simple answer is they should not and in the long run, they cannot! I would hate to be the bureaucrat assigned to defend the code requirement in court if it ever comes to that. There is no significant data to support the continued need for code, no logical justification based on current technology and, quite to the contrary, a strong case can be made that the code requirement is clearly discriminatory against certain categories of protected individuals.

Don't get me wrong here—I'm all for an incentive licensing system based on technical merit as it relates to the real needs of our hobby—but I do take issue with the requirement to master a long-irrelevant psycho-motor skill which unfairly excludes otherwise fully qualified and capable people from the hobby.

The survey

So now the ARRL has decided to fund a study of our current opinions about retaining the fast code license requirement in preparation for the upcoming World Radio Conference, WRC-99.

Although I have not been solicited to respond to the survey by their contractor (the READEX Company) and am apparently excluded also from replying to their request in *QST* for input from members (presumably ARRL members,

which I am not), I would like to take this opportunity to express my thoughts on the issue.

My initial impression upon reading through the survey form was that several of the questions are so poorly worded as to be misleading and likely will be misinterpreted by many of the respondents. Other questions have multiple premises which offer the possibility of at least four conditions, the responses to which will be impossible to accurately interpret. Many of the other questions seem to be asking virtually the same thing over and over, with most of the possible answers indicating a preference for at least some level of code speed proficiency—not a very good way to get unbiased results.

The likely results of such a survey are rather predictable—ARRL members who have already passed their code test will favor its retention and nonmembers who aspire to upgrade will tend to vote in the opposite direction. Unfortunately, the voice of the vast majority of technically qualified but as yet unlicensed individuals will be virtually unrepresented in the results of the survey. And it is among this last group that we suffer our greatest loss, for it includes many of our newly trained scientists, engineers and technicians, who could contribute greatly to the hobby but who are excluded by the outdated, outmoded and just plain foolish code speed requirements.

The ARRL survey has three sections covering the international requirement for Morse code, U.S. licensing requirements and personal data. The questions are repeated below, along with my comments.

PART I. Morse Code

1. Which of the following two statements is closer to your opinion with regard to a possible change in the international regulations?

A. The Morse code requirement for Amateur Radio licensing is no longer relevant, or soon will not be relevant, in the international regulations. *Comment: This option requires the respondent to make a conclusion about the current position and future action of an international body—a speculation which is beyond his reasonable knowledge. The question is confusing and does not give him a real opportunity to simply select his position, thus likely biasing the overall result.*

B. For the foreseeable future, it is important to retain the Morse code requirement in the international regulations. *Comment: This option, in comparison to the previous one, gives the respondent a simple and direct way to state his opinion—in favor of code.*

2. Please SUPPORT the reasons for your position by indicating your agreement or disagreement with each of the following statements:

A. Each country should be able to make up its own mind whether to have a Morse code requirement, or not. *Comment: Presumably this refers to each country that is a party to the agreement. Since not all countries are, and all countries have a sovereign right to do what they want about requiring code anyway, it seems like sort of an odd issue to pose to U.S. amateurs. Since it is a truism, most U.S. amateurs would probably agree we should not attempt to tell other countries whether or not they should have a code requirement. The real issue is, should the FCC (at the ARRL's urging) require U.S. citizens to learn code at a specific speed of up to 20 wpm? Since the FCC has been requiring this for many decades without any international requirement to back them up, can we now expect the FCC and ARRL to be preparing the way to continue a code requirement in the U.S. even if it is dropped elsewhere around the world? This of course would be really dumb, but it also would be in line with the ARRL's long-standing preference for fast code.*

B. The Morse code is still important because it helps amateurs to communicate across language barriers. *Comment: While it is undoubtedly true that code is "still" used, the issue is one of "importance." Computers and other types of digital communications are far more efficient in this regard. To cling to a requirement for a manual capability to communicate in code for this reason, to the exclusion of other far better methods, is misguided.*

C. The Morse code requirement helps insure that radio amateurs are disciplined operators. *Comment: Clearly, this one is not verifiable in any way, shape or form, and there are just too many glaring examples to the contrary. I also wish all hams to be good and decent people, but code is not the answer to any part of society's ills and it's embarrassing to see hams being asked to parrot such ridiculous claims.*

D. The Morse code is a good thing to know, but it should not be a licensing requirement. *Comment: This is one of several two-part questions that offer four possible outcomes. Suppose someone thinks code is dumb, never uses it and has even lost all code capability, but selfishly wants it retained as a license requirement in order to reduce clutter on the bands? And regardless of how he checks the boxes, they won't have the foggiest idea of what he really thinks. It simply is an example of a bad question.*

E. Knowing the Morse code just isn't important any more. *Comment: This question is an excellent example of steering the respondent to the desired conclusion by a variety of preceding questions stated in such positive terms as to elicit a desired reaction type response. Besides, as in the previous question, simply "knowing Morse code" isn't the issue—using it at a specific speed is, and the speed requirement has nothing to do with international agreements.*

F. If rules for Amateur Radio were being written for the first time today, there would not be an international requirement of Morse code ability for access to the HF bands. *Comment: Again, as in Question 1, the respondent is being asked to speculate and make predictions about the possible actions of an international body of which he has very little knowledge. The value of any response to such a statement is questionable. If the word "should" had been used rather than "would," at least the respondent could have reflected his own opinion in his response.*

PART II. License Requirements

Comment: Almost all of these questions are concerned with current FCC requirements (instigated by the ARRL) relating to code speed and incentive licensing, neither of which results from or has any impact on international agreements. This unfortunate juxtaposition under the guise of preparing for WRC-99 serves to reinforce the erroneous association in many hams' minds that code speed licensing requirements are somehow a result of international agreement. Again, this is an example of steering the respondent and, unfortunately, there is no way to eliminate the resulting bias from the results.

PART III. Personal Information

Comment: Somewhere among all these demographic questions about age and license class, etc., it would have been instructive to have asked about the respondents' real code capabilities at present, educational attainment and technical contributions to the hobby, such as patents and papers.

So what will the survey really contribute to the body of facts that should be used in developing our position on code for WRC-99? Apparently very little. Our position should be based on what is good for amateur radio, and not on the desires of a small proportion of hams—hams who simply want to protect or enhance their own privileges.

The real issues used to decide our position should be ones of fact, such as:

• How does a code proficiency contribute to amateur radio?
Facilitates international communications.
Provides somewhat longer-range communications.

• How does a code requirement detract from amateur radio?
Excludes a large number of technically qualified individuals from the hobby.
Has resulted in underutilization of frequencies and their loss to commercial interests.
Has contributed to the erosion of U.S. amateur radio equipment development and manufacturing capabilities.
Has slowed the development of competing technologies for impressing intelligence on RF carriers.
Discriminates against some handicapped individuals.,

Too bad the ARRL survey will not be able to provide meaningful data on the really important issues. Let's hope the U.S. representatives to WRC-99 will be able to see beyond any misguided attempt to influence their recommendations with "cooked" survey results and act in the best interests of all our citizens, not just currently licensed hams.

NEVER SAY DIE

Continued from page 17

are also not available to the public? That's weird! It's almost enough to make someone suspicious.

Bill, who worked for Rocketdyne for seven years, designing and building rockets for NASA, had his curiosity aroused when he heard that the lunar missions would be using rocket engines which he knew were far too small to lift the lunar payloads. The larger engines, which had been designed to take people into space, had all failed. 13 consecutive failures! He knew that the smaller engines that were being used couldn't possibly do more than lift a rocket with no payload. Hey, what's going on here? And then, after this long string of failures, the moon missions came off one after the other like clockwork. Hmmm.

It's sure an interesting book, but since you know that your government could never keep anything this big a secret, you probably won't want to bother reading it. Just chalk this up to poor old Wayne falling out of his rocking chair and probably hitting his head. Or being incredibly gullible.

If you'd like to read Bill's book I'll have him make up some copies. $25, plus $3 s/h from Radio Bookshop, 70N202, Peterborough NH 03458. Cash, check, money order, Visa, MasterCard, or what have you to swap?

Scientist Welfare

Congress sure has a lot of fun spending our money. Being interested in science, I almost get upset when I see Congress throwing money away on projects that don't make good scientific sense. Sure, I realize that Congress is made up mostly of used lawyers who haven't a clue when it comes to science, so they can be easily gulled by our beloved scientific establishment. You know, the turkeys who have managed to ignore virtually every major scientific discovery in history.

So they blew a few gigabucks on that big hole in the ground down in Texas. The supercollider. And they're still throwing gigabucks at the NASA Mars project. Did

anyone notice that Russia got all over their desire to send men to visit other planets when they found out that their astronauts would get fried by solar flares if they ever ventured outside the protection of the Van Allen belt? The Russian space effort is just about closed down now. Oh, they have the money, if they want to use it—I noticc that they haven't slowed down on their building of new and more advanced nuclear submarines. Hmm, I wonder what they need *those* for?

Then there's that $200 million shoulder of pork being spent on the HAARP deal in Alaska. I've mentioned this scam before. The idea is to shoot 1.7 billion watts of RF into the ionosphere and let's see what happens. That's a lot of juice, but it's a piffle in the wind compared to the soup arriving from the sun from solar flares.

There are a bunch of basic research projects which really could use some funding, so I hate to see Congress blowing money on pork fat like the Alaskan HAARP and Mars charades.

Pork Chop Hill

Despite all that campaign rhetoric about the deficit and cutting the budget, the guys you recently blindly re-elected (despite my warnings), have been busy pigging out on your money. As hams, I suppose we should be tolerant of pork, such as the $25 million for our wonderful friends in North Korea. Hey, we sure don't want to watch our good communist buddies go broke building tunnels under the DMZ, right?

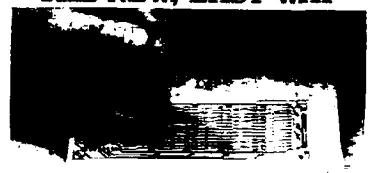
How about $1.9 million to supervise a Teamsters election? Or $3 million for a New Orleans Jazz Historical Park. And $1 million for the Center for Irish Management. Hmm, are those pesky Irish getting that far out of hand? Or around a half mil for the Applewhite Picnic Area in California. And $8.6 million for anti-terrorist operations by the National Park Service. So *that's* where the terrorists are concentrating their efforts! Manhattanites, you can relax.

Hey, it's *your* money they're having all that fun with. Next time get out there and vote and be sure to Never Re-elect Anyone (NRA). Let's flush that lousy Washington toilet and send all those professional politicians home to find honest work. Back to their law firms.

Superhuman

Every now and then I read about someone doing something superhuman under extraordinary circumstances. A mother lifts a car off her child, for instance. And many hypnotists have demonstrated amazing feats of strength or enhanced other abilities with their subjects. LSD users will tell you about their incredibly enhanced senses of taste, smell, hearing, and extrasensory perception (yes, I did LSD back in 1960 and it was an incredible experience!).

Continued on page 43



Are You Ready To Recharge?

Learn about a new battery technology—then build the project to utilize it.

Sam Ulbing N4UAU
5200 NW 43rd St. Suite 102-177
Gainesville FL 32606
E-mail: n4uau@afn.org

One of the fun aspects of ham radio is that electronics technology changes so fast. It seems every week a new product is announced that can affect ham radio—I recently learned about a relatively new battery technology and discovered a chip that I could use to build a charger for this battery. If you're not familiar with "rechargeable alkaline batteries," read on. I think you'll agree that they offer advantages for the radio amateur.

Building the charger is an easy project and the batteries are inexpensive. Once you've built the charger you can try using rechargeable alkaline batteries and see how well they perform for your applications.

What are rechargeable alkaline batteries?

The technology for these batteries is quite new—it was developed in 1986 by Battery Technologies, Inc., and the batteries were first introduced in September of 1993 by Rayovac™ under the brand name RENEWAL© (several other manufacturers are also producing rechargeable alkalines now). A charging chip, the bq2903, was released to the industry and to the public by Benchmarq™ in the spring of 1996. Prior to this only the Rayovac recharger was available.

Normal alkaline batteries are "primary" batteries; that is, you use them until they are dead, then throw them away and go buy more... and more and more. Rechargeable alkaline batteries are modified alkaline batteries which, like NiCds, are "secondary" batteries that can be used over and over, but their features are quite different. Under the right conditions rechargeable alkaline batteries can be used and recharged hundreds of times. Under the *wrong* conditions they can be destroyed after only a few uses.

These batteries are still new enough that you might have to hunt a little for them; they can be found at mass marketers like Wal-Mart™, KMart™, Target™ and ACE™ hardware. I also found some at the local supermarket but could not find any at Radio Shack™. To raise consumer awareness, Rayovac has been running an ad campaign for them featuring Michael Jordan, so you may soon be seeing more of them.

"If you use a NiCd charger to charge rechargeable alkaline batteries you'll kill them."

Why would you want rechargeable alkaline batteries?

• Compared to using alkalines, you could save money. A package of 4 primary AA alkalines costs about $2.80, while four rechargeable alkaline batteries cost about $5.50 and four NiCds are about $10.50. If you have an application that needs 5 volts at 125 mA and runs only half an hour a day, over three years you will have to buy 34 sets of 4 alkaline batteries at a cost of $95.20. With proper care, the rechargeable alkaline batteries should still be good and you will have saved $90. The NiCds would also be good but the rechargeable alkaline batteries are still less expensive.

• Compared to NiCds, they have a much longer shelf life. This means you can depend on them when you need them. Fully charged rechargeable alkaline batteries will still have 96% of their charge after sitting around for a year. If you leave fully charged NiCds unused for only three months, you will have to recharge them before you can use them because they will only have about 25% of their capacity left.

• They are environmentally friendlier than NiCds because they contain no cadmium—and you discard fewer of them than you do primary alkaline batteries.

The right conditions

Each battery system has different strengths and weaknesses. Selecting the best battery for a particular application requires knowing the right conditions for a particular battery. Rechargeable alkaline batteries work best under the following conditions:

• *Low current use*

Because of their construction rechargeable alkaline batteries have a rather high internal resistance. For this reason they work best when the current draw from them is limited to a few hundred milliamps. A continuous current draw of less than 400 mA is best although they can supply up to 1 amp in instantaneous peaks with a reduced voltage. Studies done by Rayovac show that a rechargeable alkaline battery which is always deeply discharged (to 0.9 volts) before it is recharged will lose about half of its initial capacity by the 25th use. Even so, at low current levels the overall capacity available for the first 25 uses of rechargeable alkaline batteries is about equal to that of 10 primary alkalines and as good as or better than NiCds, even

assuming NiCds lose no capacity with use (see **Table 1**). This might be considered a worst-case use (under proper use) of the batteries.

• *Recharge often*

Rechargeable alkaline batteries like to be recharged often—exactly the opposite of NiCds which can lose capacity from "memory" effect if they are not fully discharged before being recharged (see Author's Note). Rechargeable alkaline batteries gain capacity from frequent recharging so you don't have to worry about doing it too often.

Rayovac conducted a test in which batteries were discharged at 400 mA for 10 minutes and then immediately recharged. This cycle was repeated several hundred times with no significant change in cell response observed. In this case the battery capacity was greater than 53,000 milliamps/hours, 26 times as much as for a primary alkaline battery. This is probably a best case for the battery, but under proper care you could get somewhere between 10 and 25 times the life of a primary alkaline battery.

• *Recharge properly*

NiCd chargers use a constant current charge technique and measure either cell voltage or temperature to terminate the charging. If you use a NiCd charger on rechargeable alkaline batteries you'll kill them quickly. The proper method is to pulse the current to the battery and in between pulses check the no-load cell voltage. The average pulse current needs to be reduced as the battery voltage increases to avoid overcharging. This project uses the proper charge method.

• *Avoid deep discharging*

Rayovac and Benchmarq both clearly state: "The most important factor in maximizing the cycle life of reusable alkaline batteries is the avoidance of overdischarge or cell reversal." We have seen that cycling batteries to 0.9 volts gives less capacity than short cycling. Discharging below this voltage level will significantly shorten battery life. NiCds, too, are injured by overdischarging and cell reversal, but it appears that for rechargeable alkaline batteries the damage is much more severe; that's why the Benchmarq charging chip is designed to be used *with* the battery pack, when the battery pack is in use, to prevent overdischarging.

We've focused on AA batteries. C and D cells will have more capacity than AA cells but the optimum rate of charge and discharge appears to be about the same as for AA cells. This means that you will get more hours of use from the larger sizes—but probably not much more peak current output. The charging circuit (**Fig. 1**) will work with the larger sizes but it will take longer to fully charge the batteries.

Charging the batteries

When you first power up the charger, it checks to see if any cell has a voltage of less than 0.4 volts, and indicates a defective cell fault by flashing the "CHG" LED. If no cell is less than 0.4 volts and the voltage at pin 13 is 2.7 volts or more, it starts the charge cycle (the "CHG" LED is on continuously, not flashing). The bq2903 uses a pulsed current charge method. An internal FET is switched on for 7.5 ms and then off for 2.5 ms by circuitry internal to the bq2903. The chip monitors the voltage of each cell between pulses.

Current Demand	100 mA	300 mA
Alkaline Primaries	2,100 mAh	1,550 mAh
Rechargeable Alkalines	25,000 mAh	15,000 mAh
NiCds	17,500 mAh	15,000 mAh

Table 1. *Comparison of cumulative battery capacity over 25 uses (discharging to 0.9 volts with each use).*

Note that the charge current is applied to the whole stack of cells at pin 14 and not to each individual cell. Pins 1, 2, and 3 are used only to monitor each cell's voltage—a compromise, because ideally each cell should be charged and monitored. This compromise is quite acceptable as long as cells are matched. Charging new and old batteries in the same stack is not recommended, because of their change in capacity. If, during charging, the bq2903 measures any cell voltage greater than 1.63 volts, it skips charge pulses until all the cells drop below 1.63 volts, or until so many pulses are skipped that the average pulse charge rate is 6% of the maximum charge rate. At this point charging is terminated. The "CHG" LED turns off and the "DONE" LED turns on.

After charging, the charger stays in the monitor mode checking battery voltage. A trickle charge is not needed as it is for NiCds because of the very low discharge rate of rechargeable alkaline batteries. If the batteries were left in the charger for a very long time, and all cells fell below 1.4 volts, the charger would initiate another charge cycle.

R3, R4, and R5 limit current to the chip. The capacitors are for transient suppression.

If you wish to modify the circuit to charge only three cells, you can do this by disconnecting Nsel (pin 4) from Batlp (pin 14) and connecting it to Vss (pin 10 or 11). You also need to connect pins 2 and 3 since only 3 cells are in use.

The maximum recommended charge rate for the bq2903 is 400 mA and the maximum voltage is 10 volts. The power source must limit both. A minimum of 8 volts is necessary for four cells. Lower charge currents will permit deeper recharging. I decided to limit current to about 300 mA. 12-volt transformers are inexpensive and readily available so I used one for my power source. Since wall transformers do not regulate the output voltage nor limit the current, I used two LM317 regulators to limit the maximum current to 300 mA and maximum voltage to 9 volts.

It is possible to use a standard four-cell battery holder with the charger but it must be modified—and that may be difficult. The need to measure the voltage of each cell requires that a wire be soldered to each spring terminal of the holder. I succeeded once but another time the heat melted the plastic and I ruined the holder. Using four single-cell holders will permit access to each cell (**Photo A, Photo B**).

Using the bq2903 to control end-of-discharge voltage

You can remove your batteries from the charger and use them when they are charged. If you follow the guidelines, you should get a long life from them.

If your application has room to include the charger circuit, the bq2903 will also monitor the cell voltages as they are discharged and disconnect the battery source from the load when the voltage drops to a set level. Pin 5 is used to set the shutdown level. Because the voltage is being monitored under its discharge load, the measured voltage will appear lower than the actual cell voltage. For best results, that end of discharge voltage should be set as shown in **Table 2**.

The bq2903 terminates discharge by disconnecting the internal discharge FET and entering a standby mode drawing only 1 μA.

Component Values for Schematic (all 1/4 watt)	
R1, R2	620 ohm
R3, R4, R5	1 k
C1	1 μF
C2, C3, C4, C5	0.1 μF
D1	Red LED
D2	Green LED

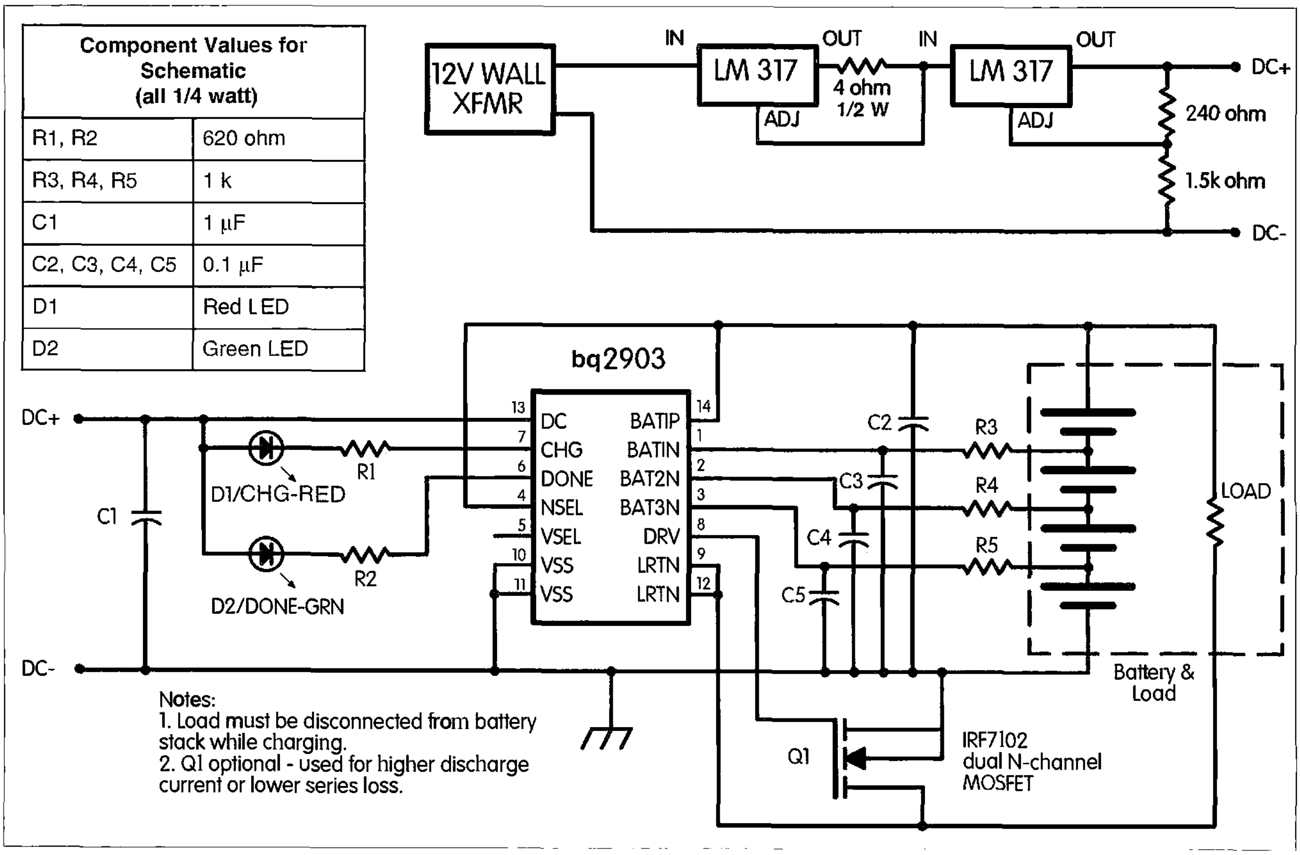


Fig. 1. The author's charging circuit.

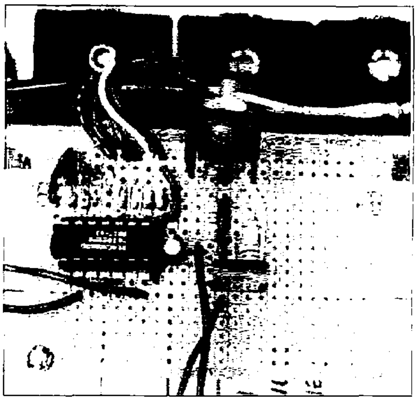


Photo A. A prototype recharger, built on a Radio Shack universal PC board.

The discharge FET is between the load return and Vss (the bottom of the battery stack). The resistance of the internal discharge FET is about 1/2 ohm. Discharge loads should be limited to 500 mA. At higher loads it is possible to use an optional external FET in parallel with the internal FET. Pin 8 is used to control the gate. If you are not using an external FET then leave pin 8 unconnected. The external FET must be a low resistance logic level FET, like the type shown in the schematic.

I've been using rechargeable alkaline batteries for about a year. I have not done scientific testing—I'll leave that to the engineers, but I *have* tried them in a variety of situations.

I've used rechargeable alkaline batteries to power the "SMALL" audio amplifier circuit (*QST*, June 1996) I built (with the 7805 removed). The "SMALL" can require peaks of 400 or more mA. I found no difference in audio volume (which depends on input voltage) between using rechargeable alkaline batteries and NiCds. I have let it sit for long periods with rechargeable alkaline batteries in it and occasionally turn it on. It still sounds good.

I've used rechargeable alkaline batteries in my handheld GPS. If you have one you know that they eat up batteries at a rapid rate. Primary alkalines lasted about 10 hours. NiCds and rechargeable alkaline batteries both lasted about half as long. If you plan to use your GPS only for short periods and then store it for a few weeks, rechargeable alkaline batteries will keep it ready to go.

Life-testing batteries takes a long time and there are many variables. I'd be interested (and I suspect *73* would be, too) in hearing what those of you who do this project learn. No one battery is perfect, but knowing *which* one is the best for an application can help you get the most from these expensive power sources. For those of you who are inter- ested, more information may found on the World Wide Web: http://www.rayovac.com/business or http://www.benchmarq.com.

The bq2903 is only available from wholesale distributors at this writing. However, a parts kits with PC board and all the parts shown in **Fig. 1** except Q1 and the wall transformer are available from me for $17.50 including shipping (Florida residents please add sales tax).

Author's Note: There are various opinions on memory effect: Recently a column in QST *(October 1996) suggested that memory effect does not normally occur. I offer this, based on a statement by John Wettrroth of MAXIM, who wrote in "Ideas For Design"* (Electronic Design *Magazine, January 22, 1996): "The microcrystalline cadmium in a NiCd battery's anode will slowly begin to change if left undisturbed. Tiny crystals in the metal coalesce into larger ones, producing an increase in battery resistance that lowers the terminal voltage. This effect can become noticeable when repeated partial discharges leave the lowest layers of cadmium unaffected ... as a result, a full discharge eliminates the reduction in terminal voltage, sometimes (erroneously) called the memory effect."* 73

For discharge rate of	End of discharge voltage (per cell)	Connect Vsel to
50 mA	1.1 volts	pin 14
100 mA	1.0 volts	not connected
more than 200 mA	0.9 volts	pin 10 or 11

Table 2. End of discharge voltage.

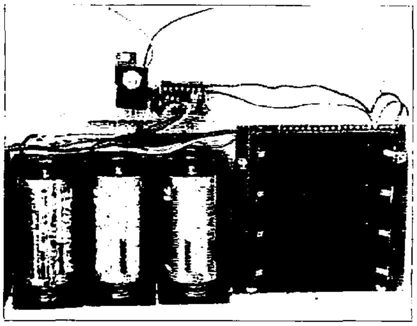


***Photo B.** Notice the recharger is set up to charge either "AA" or "C" batteries.*

NEVER SAY DIE

Continued from page 39

Then there are people with special abilities—math, memory, musical, etc. Prodigies.

All these experiences tell us what the human body/mind is capable of doing. The question is, how? If we can understand how people can do these things, perhaps we can harness it for everyone's benefit.

Let's also include "spontaneous cures" for serious illnesses, while we're at it.

You don't have anything better to do, so get busy on this.

Virus!

We all catch colds and the flu every now and then, right? While we're able to catch germs and viruses in different ways, generally we think of it as being through physical contact, or perhaps airborne (like from a sneeze or cough).

I've had less trouble with catching colds since reading an article which recommended shaking hands with the right hand and using the left to touch my nose or lips. At trade shows, hamfests, and conferences I try to remember this warning, and it's pretty well ended my coming back sick after shows.

Of course another pretty good way of avoiding colds and flu is to keep your immune system strong and avoid stress. I do my best to keep my immune system strong by getting the best air, water, and food I can, by adding missing minerals and vitamins to my diet, and by avoiding obvious poisons such as nicotine, alcohol, mercury (via dental fillings), root canals, aspartame (a.k.a. NutraSweet™) and electromagnetic fields.

I get out there and exercise every day, letting some of those valuable sun UVs into my eyeballs.

But there's another source of viral contagion which has been hushed up by our trusted medical industry. I got the first hint of this when I read the Hoyle-Wickramasinghe book, *Diseases From Space*, which showed that most of the world's more serious plagues started

Continued on page 47

Top-Fed, Out-of-Phase, Phased-Verticals (TOP) Antenna

Computer simulated and field tested.

Nizar A. Mullani KØNM
719 Santa Maria
Sugar Land TX 77478
E-mail: K0NM@amsat.org

Here's a new, simple phased-verticals antenna that is easy to build and which does not require ground radials or a counterpoise. The antenna consists of two half-wave radiators with a 180-degree phase difference that is fed at the top with 50 ohm coax. Computer simulations and prototype tests show an SWR of less than 1.4 to 1 and the radiation to be a bi-directional figure-8 pattern that is in line with the two vertical radiators.

HF possibilities are appealing because no radials are required and the separation between the verticals is quite small. In fact, it can even be made to rotate (only for an unguyed tower) by attaching the antenna to the boom of a yagi. Or, the antenna can be turned to the horizontal position for an end-fed two-element out-of-phase bi-directional antenna.

In the VHF frequencies, where the antenna is suspended several wavelengths above ground level, the TOP antenna will not match up to the gain of a yagi; however, it will have a couple of dB gain over a J-Pole antenna. The bi-directional nature of the radiation pattern makes it an ideal antenna for stations located between two major cities.

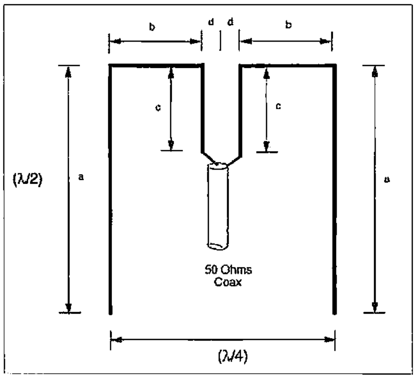


*Fig. 1. The TOP antenna, showing the approximate dimensions and the feedpoint. Values for the different lengths and spacing are shown in **Table 1**.*

Just the facts

Radiation patterns from phased verticals vary, depending on the spacing between the verticals and the phasing of the radiators. The feedline coming from the transmitter has two lines which are 180 degrees out of phase at any one time. Therefore, feeding the two vertical elements with each end of the feedline automatically causes a 180-degree out-of-phase feeding of the two elements of an antenna.

Most phased verticals have feedpoints at the bottom, with feedlines of different lengths to provide the phasing and extensive ground systems. Unfortunately, the wires that connect the vertical radiators carry a fair amount of current close to the ground and the radiation from these wires is absorbed by the ground. Feeding the antennas from the top elevates the high current points to a higher level away from the ground and keeps the current at the ends near the ground very low. Therefore, most of the radiating power of the antennas is raised above ground level for effective radiation of the signal and no ground radials are required. The design described here is simple, easy to build, and provides some gain and directionality in-line with the two phased elements. Additionally, it can be fed directly with 50 ohm coax for a low SWR, and overcomes some of the complexities inherent in these antennas.

The design of the TOP antenna is shown in **Fig. 1**. The antenna is basically two half-wave vertical radiators fed at the top with a feedline and impedance matching section that is part of the antenna. The shape of the antenna resembles the letter "m" and is symmetric about the feedpoint. The dimensions of the antenna are shown in units of wavelengths for illustration purposes. In theory, the lengths of the vertical and the horizontal sections can be any size; however, the radiation pattern and the feed impedance will change depending on these dimensions. With larger spacing, a significant amount of horizontally polarized signal will be radiated by the top horizontal feed section. Closer spacing will increase the gain but lower the feed impedance.

Getting creative

Using the AO computer program, I simulated a compromise design which trades some of the gain for ease of feed of the antenna. This design utilizes two half-wave verticals with a spacing of a quarter wavelength, and a feed system with impedance matching, to provide a feed impedance of 50 ohms. The matching section is folded down from the top as shown in **Fig. 1** to keep the total design compact.

Dimensions of Sections **a**, **b**, **c**, and **d** can be computed easily using the following equations, but there will be some deviation from these values, especially in the spacing **d** (impedance at the feedpoint). The values below will also need to be adjusted for the thickness of the wires used in the antenna. The values

shown below are for use with #12 wire.

$$a = \frac{468}{f} \qquad b = 0.160a$$
$$c = 0.36a \qquad d = 0.05a$$

where f is the frequency in MHz , and a, b, c, d are in units of feet. The size of the conductor will influence the above dimensions, especially d, which is responsible for the impedance matching.

Computer simulations of the TOP antenna

The computer simulations for **Fig. 1** (AO Program) were carried out for a perfect ground system with the antenna being one inch from the ground. A similar set of simulations were carried out for a quarter-wave ground plane antenna at the same height above ground for comparison purposes. Simulations were carried out for several different HF and VHF frequencies and the typical values useful for different bands are shown in **Table 1**. Additionally, the VHF antenna was built and tested and the results are compared to the simulations.

Computer simulations of the 20-meter TOP antenna

Using normal ground rather than perfect ground, initial computations for a 20 meters version were done using the AO program, but the final results were made using the NEC-2 program, which is better for computing the losses due to close proximity of an antenna to the ground. A center frequency of 14.2 MHz was used and the dimensions used for the antenna are as shown in **Table 1**. A quarter-wave ground-plane antenna was also simulated and the results of the two antennas are shown in **Fig. 2**. Both antennas were simulated with their lowest point being one foot off the ground. Horizontal radiation patterns show a classic figure-8 radiation pattern in-line with the two vertical radiators for the TOP antenna. (The radiators are positioned north-south.) Vertical radiation patterns show the higher gain for the TOP antenna compared to the quarter-wave ground-plane. At the five-degree angle of radiation, the TOP has approximately 4.5 dB more gain than the quarter-wave ground-plane. Also, the front-to-side comparison for the TOP antenna shows a 13 dB difference.

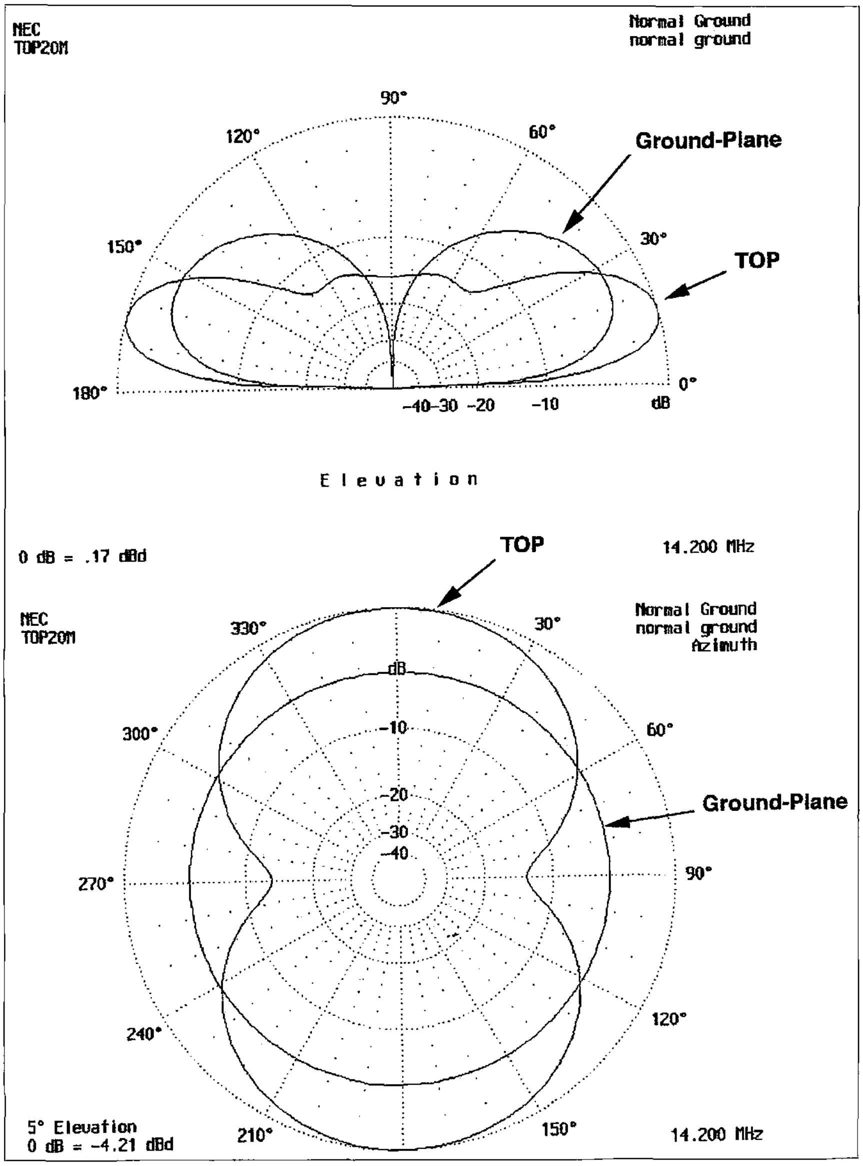


Fig. 2. Simulations using the NEC-2 computer program for a 20-meter TOP antenna compared to a quarter-wave ground-plane at a height of one foot above normal ground for both antennas.

Computer simulations of the 2-meter TOP antenna

The TOP antenna was also simulated for VHF operation, using a center frequency of 146 MHz (dimensions used in this simulation are shown in **Table 1**), along with a quarter-wave ground-plane antenna. Both antennas were positioned one inch above perfect ground for gain calculations. The radiation pattern is shown in **Fig. 3** with superimposition of the radiation pattern of a quarter-wave ground-plane antenna as a comparison. As expected, the two half-wave radiators provide a lower angle of radiation with a gain of approximately 4.5 dB over a quarter-wave vertical antenna. The radiation pattern is a figure-8 shape with the maximum radiation occurring in-line with the two vertical elements. According to the simulation program, the impedance at the feedpoint is approximately 45 ohms for 3 inch separation (d=1.5 inches) of the wires in the matching section. This impedance increases to 51 ohms with 4 inch spacing (d=2 inches) between the wires. Additionally, the SWR can be adjusted by increasing or decreasing the length of the vertical radiators.

Testing the 2-meter antenna

I built (with the help of WA5TWT) a 2-meter TOP antenna using the

dimensions shown in **Table 1**. The basic structure was built of wood and #12 wire. The antenna was fed directly with 50 ohm coax and the length of the vertical section was adjusted to lowest SWR by pruning the length. The measured SWR was less than 1.4 to 1 for operation within 2 MHz of each side of the center frequency. Rotation of the antenna yielded a bi-directional figure-8 field-strength pattern, as expected from the simulations. Field strength meter readings showed a front-to-side ratio of ten to one. Operation of the antenna at approximately six feet off the ground, with 3 watts of power, produced full quieting signal into a repeater 15 miles away and repeaters as far away as 40 miles could be used. When the antenna was rotated 90 degrees, the signal level decreased by approximately 15 dB and white noise was noticeable on the signal (courtesy K5HFY and N5EM).

Author's Note:

Since the original writing of this article, I have built 15-meter and 17-meter TOP antennas and tested them. The 15-meter was first laid out on the ground, assembled, and then raised over two branches of a tree in my back yard with the help of a slingshot and rope. The antenna was pointed north-south, of necessity.

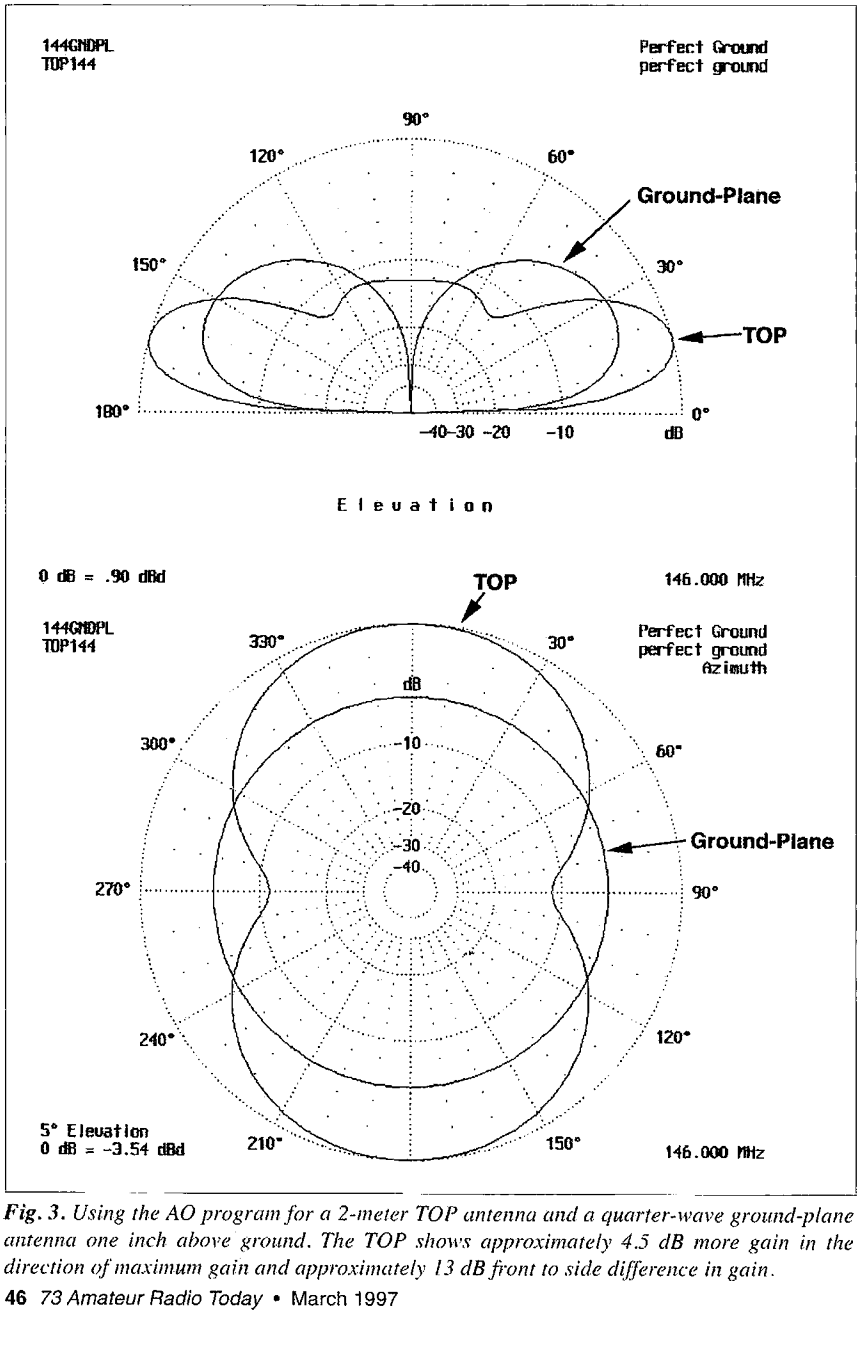


Fig. 3. Using the AO program for a 2-meter TOP antenna and a quarter-wave ground-plane antenna one inch above ground. The TOP shows approximately 4.5 dB more gain in the direction of maximum gain and approximately 13 dB front to side difference in gain.

I connected the coax to my Autek SWR analyzer and adjusted the lengths of the vertical sections to get the lowest SWR of 1.4 to 1 at 21.15 MHz. I fired up my ICOM 738 and it showed an SWR of less than 1.7 to 1 across the whole band with an SWR of 1 to 1 from 21.1 to 21.4 MHz. I didn't even need my automatic tuner to load up this antenna.

I always test my antennas using a reference quarter-wave ground plane antenna. First, I did a receive test, switching back and forth between the TOP and the quarter-wave ground plane. The South American stations were coming in one to two S-units stronger with the TOP antenna. On transmit, with 100 watts, I found the same sort of report from LU7, ZP5, XE2, TI2, WDØ in Colorado; consistently one to two S-units better.

Not being satisfied with the success of the 15-meter antenna, I wanted to see if I could stretch my luck and little and convert the 15-meter antenna to a 17-meter antenna by simply adding a few more feet of wire to the vertical wires. Sure enough, adding six feet to each end brought the SWR down to 1.5 to 1 at 18.09 MHz and my ICOM got generous and gave me 1 to 1 SWR across the 17-meter band. I don't have a ground plane on 17 to do a direct comparison by I had no problems working into PY1, ZP5, or connecting with Guadeloupe on first call. That evening, I capped off the testing of the antenna with a nice QSO with Tony N5ZIT/MM, who was maritime mobile off the coast of Brazil. It was solid 5-9 signal for half an hour and one of those heart-warming conversations you remember for a long time. He had just received his August 1996 *73* and had just finished reading my article (see page 16, *73 Amateur Radio Today*, August 1996) about Vee beams with vertical tails. He was pleased to meet an author over the ether and I was glad to meet someone who had read my article.

References

1. *The ARRL Antenna Book*. The American Radio Relay League, 1995.

2. Kraus, J.D. *Antennas*, McGraw-Hill, 1950.

Frequency (MHz)	a (feet)	b (feet)	c (feet)	d (feet)	Feedpoint Impedance (Ohms)
28.2	16.5	2.65	6.0	0.825	51 + j4.9
24.93	18.77	3.0	6.75	1.0	50.6 - j5.3
21.1	22.0	3.65	8.0	1.15	50.1 - j6.0
18.1	25.9	4.15	9.3	1.3	50.1 + j6.7
14.2	33.0	5.23	11.75	1.65	50.9 - j4.5
10.1	46.0	7.36	17.0	2.3	50.2 - j4.6
7.2	65.0	10.4	23.5	3.25	53.7 - j0.5
3.7	126.5	20.25	45.5	6.3	56.0 - j5.2
Frequency (MHz)	**a (inches)**	**b (inches)**	**c (inches)**	**d (inches)**	**Feedpoint Impedance (Ohms)**
52	108	17.4	38.9	5.5	48.4 - j0.9
144	38.5	6.5	13.0	2.0	51.5 + j8.7
444	12.5	2.0	4.25	0.9	49.8 - j2.9

Table 1. Computer-simulated values for the TOP antenna designed for different frequencies. The values for the HF bands are in feet and those for the VHF antenna are in inches. The parameters a, b, c, and d are shown in Fig. 1. Some adjustments were made to these values in order to achieve a compromise between gain and SWR. Spacing d can be varied after the antenna is built to influence the impedance at the feedpoint. Also, the length a can be adjusted for best SWR measurement.

3. Beezley, B. The AO Program and NEC-2.

Acknowledgments

I want to thank my son Ethan and my wife Linda for putting up with the sticks and pieces of wire I stuck together as prototype antennas around the house.

NEVER SAY DIE

Continued from page 43

simultaneously in many different areas, all right after the passing of a comet. They then rapidly spread out, often much faster than they should have if they were just being carried by people traveling.

Here's something to think about. Twenty-five years ago S. P. Shchurin, with two colleagues at the Institute of Clinical and Experimental Medicine in Novosibirsk, Russia, placed two identical tissue cultures in sealed glass jars. They introduced a lethal virus into one of the jars which promptly destroyed the tissue colony. The second jar remained unharmed, as you would expect.

Then they repeated the experiment, but with a quartz divider between the two cultures instead of glass. Not only did the infected colony die, but so did the second colony, even though there was no way physically for the virus to get into the other sealed jar. Somehow the virus was able to go via UV light from one colony to the other. Think about the implications.

Yes, of course they repeated the experiment, and they found that when the first colony started to die that the UV radiation from it increased significantly.

It's easy to understand why our medical industry has chosen to ignore this, with no follow-up which I've ever seen reported. Check it out in *Alternative Science* by Milton. This book will have to be added to my list of books you're crazy if you don't read. It's full of stuff our scientific betters would prefer to ignore. $15 plus shipping from Park Street Press, Rochester VT 05767. Fascinating book.

DX News

I've got some permanent scars where the DX bug bit me—and a world of memories of working DX, and then being DX. Like operating from a desert island (KC4AF and KC4DX), like operating from a King's palace (JY1), like operating from the famed American Embassy in Tehran and the DMZ in Korea. Bragging? Of course I am. But more to goad you into having fun, too, than in fluffing up what's left of my tattered ego.

Anyway, I see that *The DX Bulletin* has merged with *The DX Reporter* into *59(9) DXReport*. For $36 a year (a little more outside the US) you can keep track of the DXpeditions and any unusual countries that show up. Check with Box 73, Spring Brook NY 14140. Wayne sent you.

Yes, it's a ball to work DX, and I'm looking forward to old Sol getting acne to perk things up for us. But, like any other enthusiasm, please keep DXing in perspective. When conditions are good it's easy to work 100 countries in a weekend (during a contest, natch). 200 took me a couple months. 300 took me a year. Somewhere around 340 I stopped counting. Working DX should be fun, not a dominating factor in one's life.

Almost anyone can work a station anywhere in the world if the time and bands are right, so all a big DX score proves is that you've spent one hell of a lot of time doing something of almost no consequence or redeeming value. And you know as well as I that most of your contacts over 300 countries were momentary signal reports. Piffle.

I have a secret for you. I've visited hams in well over a hundred countries and with almost no exceptions they are interested in talking with people, not in providing them with a rare QSL card. Hams in the rarer countries really hate what DXCC and the Honor Roll has done to them. It just isn't any fun to make contacts solely to fill out and send QSL cards.

But what a great feeling it is when you've made a friend in some country and then visit him in person. I loved it when VK6RU pulled out my QSL to show me. Ditto 5Z4ERR, 9N1MM, YK1AA, and a bunch of others.

Bum Tubes

You remember tubes, right? Well, if you can find replacements for bum tubes there are tons of old ham rigs which are as good as gold. Pennies on the dollar at flea markets. But, alas, getting working replacement tubes is not easy. You have to go to antiques dealers for 'em now, and that's no guarantee that what you get will work. Maybe you'd better look for a tube tester at the next flea market so you can check out the tubes you buy. I have a very frustrated letter from a reader who had endless trouble getting good tubes from an antiques dealer (not one of our advertisers, thank heavens). For my part, I'm having a lot of trouble finding a reliable replacement quenched-gap for my narrow-band spark rig.

Death Sentence or Wakeup Call?

As Andy used to say to Amos, "I'ze regusted." The more I learn about our overly expensive and monumentally ineffective medical industry, the more regusted I get. The only reason you're putting up with all their baloney is because you've been conned into trusting doctors and you haven't bothered to do your homework, despite my nagging.

And one of the best examples is the

Continued on page 48

NEVER SAY DIE

Continued from page 48

cancer industry. With there being around a 50-50 chance that you're going to have to deal with cancer personally, how long are you going to wait before you take the time to learn about it?

The cancer *industry*? You bet! It's a $40 billion industry and the insiders know the whole works is a scam. The fact is a bunch of doctors already know what causes cancer, and I mean 100% of all cancers, not just one or two flavors. They also know how any cancer can be cured—simply and inexpensively—but that would put thousands of doctors out of work and raise holy hob with the whole medical industry. Golly, I wish I were exaggerating!

And the same thing holds for AIDS, the acquired immuno-deficiency syndrome. The secret for curing AIDS lies in the name of the "disease" itself. And this also provides a powerful clue for how to treat the Big C.

Sure, we've all heard about the immune system, but it's been kept mystically buried under layers of medical jargon. So let's lay out the situation simply. We have a blood system which takes the raw materials for our body which have been processed by the lungs, stomach, liver and intestines, and distributes them to the cells so they can live and divide into more cells. The lymph system fights off the invaders, and there is no shortage of them. It also rushes to repair damage to the body. Even under the best of circumstances the immune system is kept busy handling damage repair and dealing with invaders.

So what happens when we overwhelm the immune system? It breaks down and is unable to fight off its foes as well. A strong immune system quickly detects mutant cells. In any really large factory there are always some defective products. Here we're dealing with around 75 trillion cells, all busy replicating each other from every few minutes to weeks. The immune system is a quality control supervisor, checking for defective products and destroying them. Maybe one cell out of a million will make a mistake during replication. A mutation. And if this is allowed to grow it can get out of control and you have a cancer. The body is continually generating these small potential cancers and the immune system keeps finding and destroying them.

This is the source for *all* cancers.

The immune system has been designed to cope with the level of damage which human bodies have had to deal with over the last million years or so—just as the other bodily systems are designed to work with the food, water, air, etc., which human bodies have grown used to using for fuel.

Now let's go to 1997 and the many poisons which we inflict on our bodies; poisons with which the immune system has to cope. Between immunization shots, mercury from dental fillings, chlorine and fluorides in the water, all kinds of pollutants in the air, dioxin in the water, antibiotics and hormones in our meat, pesticides on our fruits and vegetables, hefty doses of nicotine, alcohol, poisons from root canals, and so on, our immune systems are up against a barrage of enemies far beyond their design limits for coping.

And that doesn't even count the effects of stress, which alone can incapacitate even a fairly healthy immune system.

So when the immune system breaks down and cancers get started in the weaker parts of our bodies, what do doctors do? Chemotherapy! Right! They inject a new load of deadly poisons. And they radiate. It's no wonder there are so few survivors of this madness. If you look at the statistics you'll see that our trusted medical professionals have not added one day to the life of cancer patients in the last 30 years.

So what's the answer? Good grief, do you even have to ask? If you want to cure cancer (or AIDS, for that matter) you want to rebuild your immune system. This means stopping the poison input and making sure your body gets the raw materials it needs to repair itself. Clean air, distilled water, UV rays in your eyeballs, the 90 minerals, enzymes and vitamins your body was designed to use (many of which are long gone from our supermarket food shelves), and as little stress as possible. Maybe you remember Norman Cousins and his miraculous recovery just by watching comedies and reading humor books? Laugh it up. Oh yes, and exercise. Shake your cells.

Now, the choice we all have is to either continue to beat the heck out of our immune system and wait until the wakeup call comes, forcing us to either contemplate death or a change in our habits, whichever we consider less of a problem. If we choose life we have to get busy making sure we give our immune system the best break we can right now. Hmm, will it be leukemia, perhaps aggravated by EMFs? Or maybe a brain tumor (a shortage of vanadium)? I've lost some good friends to those. Or perhaps it will just be something slo-o-w and painful like arthritis.

I don't know about you, but I'm not about to wait for the Grim Reaper to take away my mike and hand me my Silent Key. So I'm eating mostly raw food, drinking plenty of distilled water, getting my exercise every day, avoiding sugar, white flour, and poisons such as aspartame (NutraSweet), adding the 90 minerals and stuff which are missing from supermarket foods to my diet, and hyperventilating every time I think of it (our air has less oxygen in it than it used to). I also laugh a lot. Hey, have you read the Dilbert book yet? And check out the humor section of my $5 (and worth $5,000) book list.

Not only am I convinced that just about anyone can regain robust health, even if near death from cancer or AIDS, but probably from almost anything else, if they give their immune system a break. But, hey, it's your body and our culture encourages a wide variety of destructive behavior. Like Big Macs and fries, or beer and Fritos. Or (sob) Haägen Dasz coffee ice cream. When your wakeup call comes, start reading the health oriented books on my recommended list and outlive your doctor.

I wonder if you know that despite billions of dollars having been spent on cancer research that no cancer incurable 25 years ago is curable today. There has been some progress with some rare types of cancer, but for over 95% of all cancer patients all that research hasn't influenced their survival one bit. Chemotherapy? No matter how many drugs or how high the dosage, it doesn't really work (Ref: *What Doctors Don't Tell You*, July 1996).

Money Is The Root

A letter from a reader read, "I think money is the downfall of our civilization." That's empty-headed blather.

Money was a great invention. It's a way to be rewarded for your skills, knowledge, and labors. Before money people traded goods or food with each other. Trading gave people access to the fruits of other people's skills, knowledge and labors. And money just makes trading simpler.

Some things are more difficult than others to make. These days an IC factory costs billions, all to provide us with very inexpensive Intel Inside™ equipment for work and play. These billions come from the pooled money of hundreds of thousands of people—pooling their labors, so to speak, to provide even better tools for us.

Money is the root all right, but not of evil. From the money root we can grow better skills, more knowledge and more productive labor. So let's not disparage money any more than we should disparage amateur radio because we have that cesspool stinking up 14,313.

NOYB

In the it's none of your business department, a reader alerted me that Lexis-Nexis has a P-Trax data base available to the public which will provide your name, current address, your previous address, your social security number, your mother's maiden name, your birthdate, and other personal information. That's a great source of information for credit card fraud, etc.

If you'd like to request that your name be deleted from this data base you can call 888-965-3947 toll free. Wait out the message about applying in writing and stay on the line for a representative. Or fax 800-470-4365. Or write Lexis-Nexis, Box 933, Dayton OH 45401.

I'm getting too old to appreciate the benefits of a big brother snitching on me. How about you?

Star Trek Nonsense

When we finally manage to invent a space drive which will get us to the stars without taking years for the trip, I hope

we'll also have developed enough smarts not to zoom into some other solar system, look for a bright blue planet, land and ask whatever life forms we find to be taken to their leaders. That's the swash-buckling way of fiction.

Reality tells us that any civilization we approach is either going to be way, way ahead of us or way behind. And I don't mean a hundred years, or even a thousand. The difference is almost inevitably going to be millions to even billions of years, and that's beyond our imagination. Even the oldest records we Earthlings have only go back a few thousand years, so we have very little data to go on as to what humans were doing 10,000 and 100,000 years ago, much less a million.

When we take an objective look at our progress in the last hundred years as compared to the last thousand, we can see the acceleration of learning. Do we think this is going to slow down or stop in the future?

No, when it comes to our dealing with a new civilization the prudent approach will be to hang around behind an outlying planet and check things out ver-r-ry cautiously. If the place looks primitive we'd then move in, perhaps behind a moon, and send down a landing party to take a closer look. At night and in a remote area.

If they're millions of years ahead of us they'll have known all about our approach early on and they'll have already contacted us. If they're millions of years behind us we might want to set up a small base on their planet and go about helping whatever life forms we find develop into something along the line of humans, using a bit of genetic engineering. We'd probably keep a small outpost there to guide their development and keep them subtly under control. If we find the planet overrun with huge beasts which could be dangerous to human-type life development, we might want to get rid of them. You know, like dinosaurs.

Now, have I fallen off my rocker again, or does that scenario make sense? If you've been doing much reading, you know that just such a scenario is not inconsistent with Earth's archeological and paleontological record. If you haven't been reading, what *have* you been doing? That 12 years of compulsory school and maybe four years of further optional time-wasting in college were only the priming of your intellectual pump. When we get out of school we are *not* educated, we only have the tools with which to educate ourselves. Alas, most people promptly throw these tools away and settle down to a life of the three Bs: bars, ballgames, and bowling. Most of the people who've worked for me down through the years have vigorously resisted any actual education once they finally got out of school. They had somehow been totally convinced that our schools had provided the only education they would ever need and no amount of reasoning could change this deeply inculcated belief.

Unless quite a bunch of pretty sharp scientists are also off their rockers, the ETs have been here for a long, long time. It doesn't make any sense that they haven't.

The Fat Life

After having spent about 40 of my years as a fat person, from about the ages of 10 to 50, I (pardon the expression) got fed up with being fat. Sure, I'd dieted and fasted all through those 40 fat years, always bouncing (oops) back to el bloato shape (250-260). When I was 50 I spent about nine months on a 1500 calorie a day regimen and dropped 85 pounds. That's about two pounds a week. I didn't want to take off the weight any faster because I was concerned that this might put an undue strain on my heart.

No, it wasn't easy. There were endless enticements to splurge, but I managed to stick at it and the fat melted away. Even better, I'd changed my eating habits enough so that once the flab was gone it stayed off. It does mean taking home larger barf bags from restaurant meals. Okay, so I get three or four meals from one restaurant dinner this way, plus plenty of exercise for my microwave.

Maybe you've noticed that there are very few fat old people. Most fatties die in their 50s and 60s, forcing the thinnies to live into their 80s and 90s in order to bring the average life span to 75. Well, that helps stave off the collapse of the social security facade. It also keeps down the queues at golf courses. Say, how old are *you*?

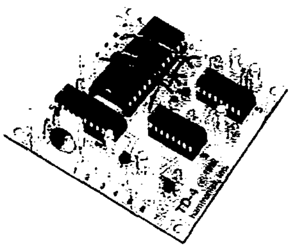
Hamfests

There are probably several factors which are gradually eroding hamfest attendance, and that's bad news for the health of the hobby. If amateur radio is going to

Continued on page 53

NEW PRODUCTS

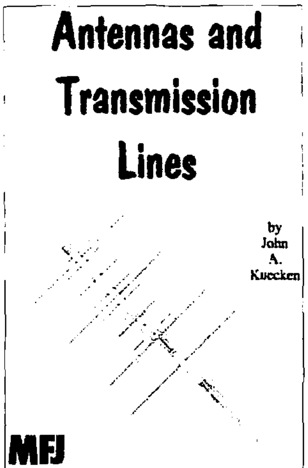
Number 50 on your Feedback card



TD-4 Selective Calling Module

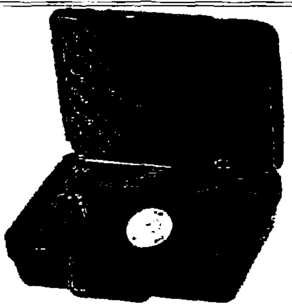
Hamtronics, Inc. recently announced its new TD-4 Selective Calling Module, an economy touch-tone decoder with one latching output. Now it's unnecessary to listen to all the activity on a channel just so someone can call you once in a while. It's easy to modify the latch input circuits on the TD-4 to perform a LiTZ (long tone zero) function for emergency use, and it can be set to turn on/off an autopatch or any other device requiring a simple ground to activate.

The 2-3/4 inch PC board is ideal for custom installations, and it operates on 12 VDC. The TD-4 is only $49 in kit form or $79 wired and tested. For more details, write to Hamtronics, Inc., 65-F Moul Rd., Hilton NY 14468-9535 or call (716) 392-9430. Ask for a catalog and tell them where you got the phone number.



Antennas and Transmission Lines, by respected author John A. Kuecken, is the newest release from MFJ Publishing. Amateur operators, technicians, engineers and students will find this book an invaluable resource. It's a handy reference guide with lots of diagrams and graphics, and direct, clear information on the theory of antennas and transmission lines.

The 37 easy-to-understand chapters deal with subjects like point array sources, standing waves, impedance matching, Q, resonant circuits, and other selected topics, such as radio-range protection. All this and lots more for only $19.95. For more information or the name of your nearest dealer, contact MFJ Enterprises, 300 Industrial Park Road, Mississippi State MS 39762; phone (601) 323-5869 or FAX (601) 323-6551. E-mail http://mfjenterprises.com; or order toll-free by calling (800) 647-1800.



The "Porta-Strip" from RF Connectors

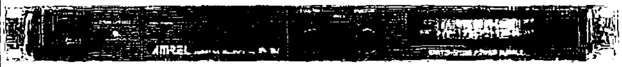
Here's the cable-stripping tool every technician's been wanting—it's perfect for professional installers, broadcast and video studios, small manufacturers and LAN installers. The RFA-4015 is small, lightweight, fast and easy to use. It's the ideal cost-effective alternative to expensive bench strippers.

The "Porta-Strip" offers quick changes with interchangeable cutter heads to fit all sizes of coaxial cable. And it comes in a slick, rugged carrying case with an AC/DC battery charger standard.

See your RF Connectors distributor, or for additional information call (800) 233-1728; E-mail: 102061.2261@compuserve.com.

Audio Transformers Catalog

SESCOM, widely known as a manufacturer of project enclosures, is proud to announce its 1997 MI-series Audio Transformers catalog for professional users. The catalog describes 59 different transformers for high quality audio applications, with technical, electrical and mechanical information. Get your free copy of this catalog by phone (800) 634-3457 (US or Canada) or (702) 565-3400. FAX (800) 551-2749 from the US and Canada (Mexico, dial 95 first); 1800-12-8491 from Australia, 0800-96-7106 from the UK; or E-mail sescom@anv.net.

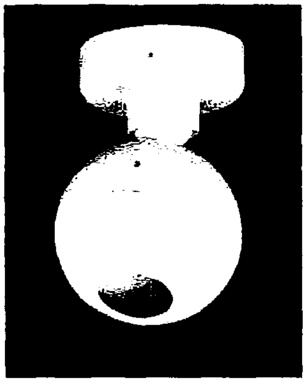


SPS Series Switch-Mode Power Supplies

Starting as low as $1,195, the SPS Series of switch-mode power supplies from AMREL/American Reliance Inc. is a no-compromise solution for your budget.

Innovative design and versatile features include: Programmable protection modes (voltage, current, temperature), fast down programming rate (1ms), low noise output (3mVrms and 30mVpp), and more.

The SPS series exceeds industry standards and offers a wide range of features for ATE, engineering, manufacturing, and scientific applications, along with a three-year warranty and toll-free technical support. For more information, contact AMREL/American Reliance Inc., 11801 Goldring Road, Arcadia CA 91006. Phone (800) 654-9838 or (818) 358-3838. E-mail: amrel@amrel.com.



Eyeball Spyball

Cool, huh? The "Smart Value" Color BC-865C from GBC ColorSentry™ is infinitely adjustable, indoors or out. You can angle the camera plus or minus 90° in any direction; look sideways or down from walls or from ceilings. The weatherproof housing means you don't have to worry about exterior installations.

The BC-865C has more than 325 lines of resolution and a sensitivity of only .4 lux. Its built-in electronic shutter and dynamic through-the-lens automatic white balance allow for true color rendition under all lighting conditions. It comes with a 6mm lens (others are optional) and a 12 VDC power module—get a high performance color ball camera for the price of black and white!

See your dealer or contact CCTV Corp., 280 Huyler Street, South Hackensack NJ 07606. Phone (800) 221-2240 or (201) 489-9595; FAX (201) 489-0111.

Continued on page 69

A Full-Time Space Shuttle Monitoring Station

Other obligations won't keep you Earthbound!

Grover C. Huckabee III K4DRF
95 Simpson Drive
Kennesaw GA 30144

It's a shame that things like making a living or family matters should interfere with our hobby—but a good ham is a well-rounded ham, and being surrounded by ham radio twenty-four hours a day is not only impossible, it's unhealthy. Still, there are things happening on the bands that would be nice to investigate, even when we must be involved in other pursuits.

Something I like to do in my shack is listen in on two-meter conversations from space. The space shuttle missions usually carry at least one licensed radio amateur, as does the Russian *Mir* Space Station. Listening to and trying to contact the Astro- and Cosmonauts is exciting, but they have limited operating time up there, and our schedules here on the ground limit us.

One way to keep in touch, even when you're not at your station, is to build a simple automatic monitoring station that will record the space side of the two-meter QSOs on audio tape. Then you can review the tapes in the quiet of the ham shack, or even in a traffic jam on the way to work. Putting together such a monitoring station can be easy and inexpensive.

You need a receiver capable of covering the frequency of interest, a carrier-operated relay, an audio cassette recorder, and a simple antenna. If you are really interested in tracking the space signals from horizon to horizon, a home-built or store-bought low noise preamplifier can be added, but it's not necessary for basic operation.

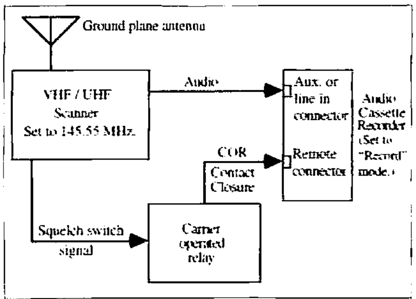


Fig. 1. Block diagram.

The heart of the system shown in **Fig. 1** is the Carrier Operated Relay. This is a simple device, and basic circuits have been described in many publications. Most applications of the COR have concentrated on its use in VHF and UHF FM repeaters, where the relay is used to turn on the repeater transmitter when the repeater receiver hears a signal. In our application, we will use the COR to turn on a tape recorder, which is listening for a signal from our receiver or scanner. A home-built ground plane or turnstile antenna, cut for the two-meter band, is connected to the antenna input of a VHF/UHF scanning receiver. The receiver I used is a Uniden Bearcat BC560XLT ($69 from a mail-order firm). The selectivity is excellent for the price, as is its sensitivity—two things to look for in a scanner. There are a couple of modifications that must be made to the scanner in order to drive the COR and the tape recorder, but most scanners are similar in construction, and a little probing with a voltmeter and/or scope should let you know where the mods must go. Basically, they consist of locating two points within the receiver and attaching two wires to bring these points *out* of the receiver and to the COR and tape recorder. The points of interest are the receiver discriminator output or squelch switch circuitry, and the audio output *before* the volume control. The discriminator of an FM receiver is the part of the circuitry which demodulates or recovers the audio from the RF signal. When there is a signal present, a positive-going voltage is usually generated in addition to the audio signal. This voltage is used to open the squelch circuit of the receiver, allowing the audio signal to be amplified and directed to the speaker. Only when an RF signal of sufficient strength is present will the squelch open and allow the audio path to function. The other factor that influences the opening of the squelch is the setting of the squelch control itself.

This control sets the threshold at which the squelch switch will open, allowing the audio path to the speaker to be completed. The tighter the squelch control is set, the more RF signal is needed to open the audio path. We can use this information to find the location of one of the wires we need to attach to make our system work, and we don't even need a schematic of the receiver to do it! We will use the fluctuating voltage that makes the squelch work to also make our COR work. The same voltage that makes the audio path of the scanner open will also be used to make our carrier operated relay close, starting our tape recording.

The only other addition necessary for a working system is to supply audio from the scanner to the audio input of the audio cassette tape recorder. Be careful to supply the recorder with audio that is always there, rather than being dependent upon the setting of the scanning receiver's volume control. Again, we will use a voltmeter to determine this point, *before* the volume control, a point where the internal audio level of the receiver is always constant. Once these two circuits are extended to the outside of the receiver, it is a simple task to make our system work.

The carrier operated relay turns on our tape recorder, to record the audio from

our scanner, once a signal is present at the discriminator. Our device will take the positive-going voltage at the discriminator or squelch switch, a voltage only present when there is a signal present at the discriminator, and convert that voltage to a contact closure for starting our audio recorder. When there is a signal present, the recorder runs, and when there is no signal the recorder stops. Also present in the COR circuit is a built-in delay that keeps the recorder running for a second or two *after* the signal disappears, so that on fading signals the recorded signal will not be choppy because of the recorder's starting and stopping rapidly. In repeater use, this circuit is usually included so that the repeater stays on between transmissions of two or more stations, so as not to overwork the mechanics of the repeater, and again to avoid the choppy audio that would result from the repeater being turned on and off rapidly, if the input signal should be weak or fading.

Putting it together

Construction of the COR (**Fig. 2**) is straightforward—it can be built on a small piece of copperclad perfboard. Layout is not critical, and neither are the parts. I chose 2N3906 and 2N3501 transistors since I had plenty of them on hand, but any switching transistors of the right polarity will do. Just make sure that the transistor chosen as the relay driver is hefty enough to dissipate the power required to run the relay continuously, since it will be turned on for long periods of time. The COR requires +12 VDC, which can be derived from the power supply that runs the scanner, or as I did it, from a separate small three-prong 12-volt regulator (7812) supply.

If you choose to run the COR from the scanner supply, make sure that the supply can handle the extra load without overheating.

R1 sets the input sensitivity to the COR. Its setting is usually not critical, but is included to allow for the variations of positive voltages available from a wide range of scanners. Q1, a 2N3906 transistor, amplifies the positive voltage from the scanner discriminator or squelch switch and delivers it to Q2, a 2N3501 transistor. This stage is used to form a delay circuit that holds the relay on, after the input signal has disappeared, for a time determined by R2. This delay time can be set from almost zero delay to several seconds. The signal is then delivered to Q3, a second 2N3501 device (the relay driver), which supplies the voltage and current necessary to close the relay. K1, the relay, can be any small 12 VDC unit.

Mods

A voltmeter is a necessity for the two modifications to the scanner (an oscilloscope is helpful, too). Most inexpensive scanners can be easily disassembled. Once that is accomplished, carefully disconnect the speaker wire plug, or better yet, position the scanner with the bottom of the PC board up, and the speaker plug still attached. This will allow you to monitor the squelch action while probing for the two mod points with your voltmeter. Find the volume potentiometer. Turn the volume up to about halfway, and open the squelch. Be sure that you are monitoring an empty channel, so you can hear nothing but noise with the squelch open. Set the voltmeter to the AC mode, lowest scale available. If you have a scope use it instead of the voltmeter to monitor the receiver audio noise. Probe each side of the volume control, while turning the volume control up and down. On one side of the volume control you should see the metered AC voltage go up and down as you move the volume control. On the other side of the volume control you should see the voltage remain constant as you turn the volume control up and down. This is where you should pick off the audio for feeding the input to the tape recorder. Make sure that when you run a wire out the rear of the scanner (to a jack or whatever) that you also run out a companion ground return. Mini-coax or shielded mike cable works well for this application.

To find the squelch switch, locate the squelch control on the front panel. Pay careful attention to how it's wired to the PC board. If you trace one side of this control you will probably see that it goes to either an integrated circuit or to a switching transistor. This control sets the threshold that determines how much signal it takes to open the squelch circuit.

Set the voltmeter to DC Volts, lowest scale, and carefully probe around the integrated circuit and switching transistor while alternately squelching and unsquelching the radio. On some pin of the IC or around the associated transistors you will find a point where the DC voltage is HI when the radio is unsquelched, and goes LO when the radio is squelched. We are looking for a point that is less than seven-tenths of a volt when the unit is squelched and more than seven-tenths of a volt when it is unsquelched. The typical swing is from near zero volts squelched to around a volt and a half when unsquelched. This is the point that should be pinned out to the rear of the radio to deliver the control voltage to the input of the COR. Again, make sure that an accompanying ground return is also delivered to the COR. Mini-coax or mike cable works well.

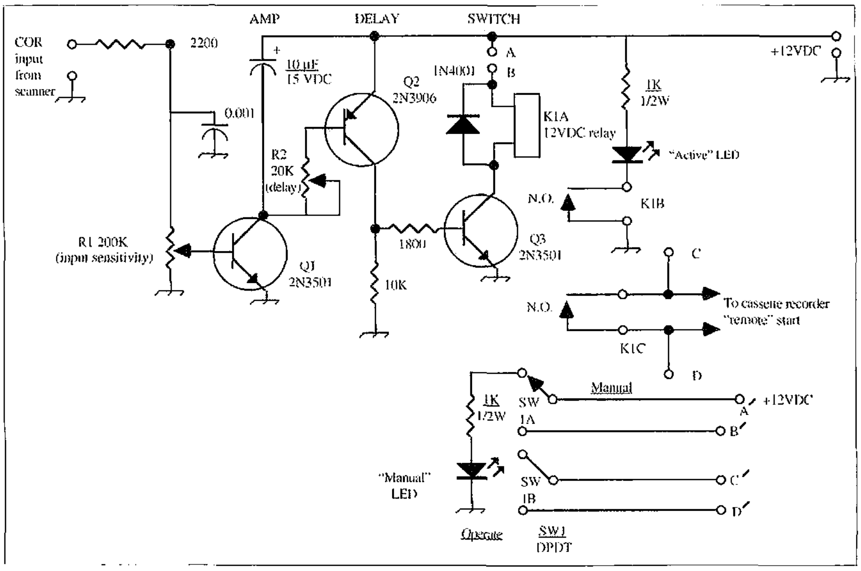


Fig. 2. COR.

Making it work

Now hook it all up and test it. Before connecting the scanner to the COR, check for short circuits with an ohmmeter across the supply voltage input and the signal input of the COR. If all looks good, then apply power. *Nothing* should happen, including smoke. Now the scanner can be mated to the COR. Turn both units off and connect the squelch switch mod output to the signal input of the COR. Turn it all on again. If it still looks good, with minimum smoke (hopefully, *no* smoke), unsquelch the radio. The "ACTIVE" LED on the COR should light, and you should hear the COR relay click. These are good signs!

If nothing happens, try adjusting R1 on the COR until something *does* happen. Leave the radio unsquelched while adjusting this control until the COR lights and you hear the relay click. Now alternately squelch and unsquelch the scanner while observing how long the LED stays lit after you have squelched the unit. Adjust R2 for a delay of at least a second and a half to two seconds. Adjustments to the COR are now complete.

Next, connect the cassette recorder to the COR and to the scanner. The output of the COR, which is the relay contact closure, should be connected to the "REMOTE" connector of the recorder. This will start your recorder when the scanner hears a signal. Make sure that the recorder control buttons have been put into the "RECORD" mode. Connect the audio mod extension from the scanner to the input of the recorder. There is usually a "LINE" or "AUX" input, on even the cheapest of portable cassette recorders. This is where the audio should be fed. If there is only an external "MIC" input, it may be necessary to make an audio pad to attenuate the audio level.

Designs for pads are available in ham publications, and consist of three or four quarter-watt resistors set between the audio source and its destination. Tune the scanner to an active repeater channel and verify that when the channel is busy, the COR "ACTIVE" LED lights, the tape machine cassette moves and that audio is being recorded (the switch on the front of the COR allows you to put the cassette recorder into a manual mode so that you may rewind and play the tape without having to pull the connection out of the "REMOTE" port each time you want to manipulate the deck).

What about antennas?

A simple ground plane antenna up about 40 feet does an acceptable job. Keep in mind that the spacecraft will be coming at you from many different angles, so a directional antenna such as a yagi will have to be constantly adjusted. If you would like to play with a better antenna than a ground plane, consider some of the turnstile designs or modified weather fax antennas described in recent ham publications.

Where are the Astronauts?

The SAREX (Shuttle Amateur Radio EXperiment) site of NASA's home page on the World Wide Web (http://spacelink.msfc.nasa.gov) will give you news about current NASA programs, activities, and even entire publications. It's an excellent way to find out about uplink/downlink changes on a particular mission. Short of that, listen in on 145.55 MHz, the worldwide FM downlink frequency, as well as the worldwide FM packet frequency.

Information on *Mir*, including predictions of when it will cross over specific worldwide cities, can be had on the Internet from the DL5KR SatTrack Prediction with modifications for WWW use by KE4AR. Just type in a key word on your favorite Web browser.

Other stuff

This system was built for monitoring manned spacecraft, but might be used for other unmanned monitoring, such as listening in on hamsats or monitoring your local two-meter net. The only limiting factor on the system is that you can only get 45 minutes of recording time per side of a cassette tape (perhaps you would like to add another timer with a loud buzzer to alert you when it's time to flip the cassette!).

Ed. note: Any modifications you make to a manufacturer's product may invalidate the warranty, so be sure of your intentions before you start your project. 73

NEVER SAY DIE

Continued from page 49

even survive we need to bring it together and get it growing again—and hamfests can be a powerful element in this mix.

Sure, I have a bunch of ideas on how hamfests can be made more fun, but only *you* know the bottom line answer to how hamfest committees can start rebuilding attendance. When is the last time you went to a hamfest? Why haven't you been to one recently? What would it take to get you to drive a hundred miles to a hamfest? Maybe even 200 miles?

What kind of activities might make you think seriously about taking a weekend off for hamfesting? Are there any ham speakers you'd drive a hundred miles to hear? How about an ARRL forum? No, I thought not. I went to one once and still haven't fully recovered. Have you got a special ham interest which might get you off dead center for a weekend: packet, satellites, emergencies, DXing, computers, certificate hunting, the ham aspects of the Internet?

Give this some thought. Hey, you might even bring it up on the air and bounce ideas around that way. Then get your word processor busy and send me a disk and hard copy. Stop making me do all the thinking. Lend a hand.

You might consider what hamfests could do to attract the no-coders, which now make up over 50% of all hams, and represent the only area of growth in the hobby. The rest of us are growing older and more crotchety, with the smokers and fatties getting their Silent Key awards from the ARRL, along with that final listing in *QST*.

And how about using hamfests as a way to get youngsters interested in the hobby? That might help bring us badly needed young blood, and thus interest a bunch of kids in getting involved with high-tech careers—something our country needs desperately.

I was 15 when I went to my first hamfest and I still remember it! Wow, I can still see that Hallicrafters Skyrider Diversity receiver, and I remember meeting McElroy, who was sitting there casually copying code at about 60 wpm while keeping up a conversation with passing hams. And one of the hams I went with (W2ECL) won the code copying contest.

What's the most fun hamfest you've ever attended? And why? Maybe we can revive the excitement that used to get us to go to hamfests.

One suggestion I've made to hamfest organizers (and in my editorials) is to offer manufacturers a forum where they would be able to explain what they've built into their newest piece of equipment. 60 years ago the features of a new receiver could be explained in a few minutes. Now, with our equipment beyond description in complexity, I'd need a half hour and a projector just to begin to explain what a new transceiver can do.

Continued on page 55

Number 54 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the July issue, you should send it in before the first of April. Provide a clear, concise summary of the essential details about your Special Event.

MAR 1

COMER, GA The N.E. GA "Bubba" Net Hamfest will be held 9 AM–3 PM at Madison County Fairgrounds, 1/2 mi. south of Comer, on GA Hwy. 22. Adm. $5; camping w/all hookups $6. VE Exams. Contact *James Daniel AE4HS, 152 Windfall Dr., Winterville GA 30683. Tel. (706) 742-2777.*

MAR 8

HAZARD, KY The Kentucky Mountains ARC will sponsor an Amateur Radio Hamfest at Hazard H.S. Cafeteria, Hwy. 15 South and Bulldog Rd. Time: 8 AM–2 PM. Adm. $2. Tables $3. ARRL Forum. VE Exams by WCARS; reg. 10 AM, testing 10:30 AM. Requires 2 IDs, license and copy, CSCEs, etc. For info contact *John Farler K4AVX, (606) 436-5354;* or *Sid Adams WI4M, (606) 439-3589.* Talk-in on 146.07/.67.

MAR 9

INDIANAPOLIS, IN Indiana Hamfest and Computer Show. See advertisement in Jan. *73*, page 43 or Feb. *73*, page 43.

MAR 13 & 27

FT. WORTH, TX The Lockheed ARC and the Kilocycle Club of Fort Worth will sponsor VE Exams for all classes at the Lockheed Rec. Area Facility, 2400 Bryant Irvin Rd. at 7 PM both nights. For details, call *Ted Richard AB5QU at (817) 293-6745.* G.R.D.L. testing done by appointment only.

MAR 15

LINDA, CA The Yuba Sutter ARC will sponsor a Swapmeet at the American Legion Post, 5477 Feather River Blvd. Hours are 8 AM–1 PM. Tailgate and commercial ham dealers welcome. An all-you-can-eat breakfast will be served 8 AM–10 PM. Talk-in on 146.085 (+) WD6AXM Rptr. Contact *Ron W6KJ, (916) 674-8533;* or *Clara KC6JPP, (916) 742-2674.*

MAR 15–16

MIDLAND, TX The Midland ARC will hold their annual St. Patrick's Day Hamfest 9AM–5 PM on Sat., Mar. 15th, and 8 AM–2:30 PM Sun. Mar. 16th, at the Midland County Exhibit Bldg. Inside Flea Market, Dealers, Tailgating, T-hunts and more. Pre-reg. is $7, $8 at the door. Tables are $12 ea. for the first four and $17 for each additional table. VE Exams at 1 PM on Sat. Contact the *Midland ARC, P.O. Box 4401, Midland TX 79704;* or contact *Larry Nix N5TQU* by E-mail at: *oilman@lx.net.* A registration form can be downloaded from *http://www.lx.net/edge/mid swap.htm.*

TULSA, OK The 1997 ARRL Oklahoma State Convention will be located in the Maxwell Convention Center, Downtown Tulsa, Exhibit Hall B (near the corner of West Seventh St. and South Houston Ave.) Flea Market spaces $6 in advance, $8 at the door. Limited to four. Banquet $20. Dealer booths $45 each sq. ft. VE Exams 1:30 PM Sat., and 9:30 AM Sun. Covered parking and RV hookups available. Talk-in on 145.27(-) and 443.750. Set up Fri., Mar. 14th 1 PM–10 PM. Call the Hamfest Hotline, *(918) 622-2277* voice mail/fax (24 hr.). E-mail *megriffin@ionet.net.* The Web site is *www.greencountry.com/hamfest.*

MAR 15 & 22

CLAYTON, MO The annual St. Louis County SKYWARN Severe Weather Observation Training Seminars will be held on these Saturdays: Mar. 15th, Mar. 22nd, Apr. 5th, and Apr. 12th. For locations, call the Severe Weather Info Line, *(314) 889-2857.* All are welcome including those from outside the area. No advance reg. required. Free parking. Certification provided free of charge, for R.A.C.E.S. and SKYWARN. Level 1 Training will be presented in the morning, with classes resuming in the afternoon for the SKYWARN Level 2 Program.

MAR 16

MAUMEE, OH The Toledo Mobile Radio Assn. will hold the 42nd Annual Hamfest/Computer Fair 8 AM–3 PM at the Lucas County Rec. Center, 2901 Key St. For details send SASE to *TMRA, P.O. Box 273, Toledo OH 43697-0273,* or *Paul Hanslik N8XDB, P.O. Box 273, Toledo OH 43697-0273; (419) 243-3836.*

STERLING, IL The Sterling-Rock Falls ARS 37th annual Hamfest will be held at Sterling H.S. Field House, 1608 4th Ave. There will be an indoor Flea Market, radio, electronic, computer and hobby items. Free parking, including areas to accommodate self-contained campers and self contained mobile homes. Dummy load available to test equipment. Tickets $3 advance, $4 at the door. Tables $5 without elec., $6 with. In groups of tables, the first table is $6, each additional will be $5. Bring your own cord. Set up Sat. 6 PM–9 PM, and Sun. starting at 6 AM. Doors open to the public at 7:30 AM Sun. VE Exams, walk-ins only. Bring current license, plus copy and photo ID. For advance tickets and tables, write to *Sterling-Rock Falls ARS, P.O. Box 521, Sterling IL 61081-0521;* or call *Lloyd Sherman KB9APW.AC (815) 336-2434. E-mail lsherman@essexl.com.* Make checks payable to *Sterling-Rock Falls ARS.* Talk-in on 146.25/.85 W9MEP Rptr. Advance tickets due to be received by Mar. 1st. Please send SASE.

MAR 22

WEST ORANGE, NJ A Hamfest will be sponsored by the Roseland Radio Club, 9 AM–2 PM at West Orange H.S., 600 Pleasant Valley Way. Adm. $5 at the door. XYL/Children under 12, free (with regular adm.). Reserved tables $12 for first, $9 ea. additional. $15 for first, $10 ea. additional table at the door. Reservation deadline is Mar. 15th, after that, first come, first served. Set up at 7:30 AM for sellers only. Special vendor parking lot. Talk-in on 147.415/146.415 and 146.520 simplex. For more details call *Jim Howe N2TDI,* or *Liz Howe N2WGH at (201) 402-6066.*

MAR 23

TRENTON, NJ The Delaware Valley Radio Assn. will host a Special Event at Tall Cedars of Lebanon Picnic Grove on Sawmill Rd., starting at 8 AM. Setup at 6:30 AM. Tailgating, covered spaces, ARRL Div. Official. Adm. $5, non-ham spouses and children free. 8 ft. tailgating space $10, includes one adm. Limited 8 ft. covered spaces $15, includes table and one adm. Limited electricity available. Advance reg. available. Talk-in on 146.670(-). For more info, write to *Hamcomp '97, P.O. Box 7024, West Trenton NJ 08628. Tel. (609) 882-2240.*

MAR 29

MICHIGAN CITY, IN The annual Michigan City Hamfest and Computer Flea Market will be held at Michigan City H.S., 8466 W. Pahs Rd, 8 AM–2 PM CST. Early set up provided for vendors. Adm. is $4, children under 12 are free with a paid adult. Table reservations and general info available from *Ron Stahoviak N9TPC, 5802 N 400 W., La Porte IN 46350. Tel. (219) 325-9089.*

APR 5

LONGMONT, CO The Longmont ARC will sponsor their annual Hamfest/Swapfest at the Boulder County Fairgrounds, corner of Hover and Nelson Rds., 8 AM–4 PM. Adm. $4, tables $8. Table reservations taken at *(303) 817-5526,* or write to *LARC, P.O. Box 86, Longmont CO 80502-0086.* Talk-in on 147.27. VE Exams, free parking. Contact *Jim Deeming, (303) 651-7764;* or E-mail at *jwdeeming@ compuserve.com.*

APR 5 & 6

TIMONIUM, MD The Baltimore ARC, Inc. will host their 26th Greater Baltimore Hamboree and Computerfest, and the ARRL Maryland State Convention, at the Timonium Fair Grounds. There will be a giant amateur radio, computer and electronic Flea Market, Show and Sale. Vendors, reserve early. ARRL Convention Program and Banquet, Huge outdoor Tailgate area. Indoor Tailgate area. VE Exams. Show hours are Sat., 8 AM–5 PM; Sun. 8 AM–4 PM. Adm. is $5 each day. Weekend adm. ticket is just $8 by advance sale. The show will be held in any weather. Dial *(410) HAM-FEST* for voice or FAX-back info anytime! Outside the State of Maryland, dial *1-800-426-3378.* Please make check payable to GBH&C, and mail it to them at *P.O. Box 95, Timonium MD 21094-0095.*

SPECIAL EVENT STATIONS

MAR 9–10

MILWAUKEE, WI The 1997 Wisconsin QSO Party will be held by West Allis RAC, 1800Z Mar. 9th–0100Z Mar. 10th. Modes CW and Phone. Request rules by writing to *West Allis Radio Amateur Club, WIQP Information, P.O. Box 1072, Milwaukee WI 53201.* Please remember to send an SASE.

MAR 15

MACON, GA The Macon ARC will operate W4BKM 1500 UTC–2300

UTC in conjunction with the 15th annual Cherry Blossom Festival. Phone 7.235, 14.240 and 21.335; CW 7.135, 14.035 and 21.135. For a certificate send QSL and a 9x12 SASE to *Macon ARC, P.O. Box 4862, Macon GA 31208.*

APR 5–6

PISCATAWAY, NJ The Piscataway ARC will operate their annual Special Event commemorating the Voice of America Relay station, WBOU, which operated during WWII in the Bound Brook section of Piscataway. The club station will operate under the club call K2VOA, and members of PARC will operate under their own callsigns signing/VOA. Operation will be 0000Z Apr. 5th–2400Z Apr. 6th. Suggested freqs. are: CW–Novice portions of 80, 40, 15 and 10 meter bands; RTTY–RTTY portions of the 40 and 20 meter bands; Phone–the lower third of the General portion of the bands on 75, 40, 20, 15, and the Novice portion of the 10 meter band. For a certificate, send a #10 or for unfolded, a 9x12, SASE and 2 units of first class postage, with your QSL, to *PARC, Attn: VOA, P.O. Box 1233, Piscataway NJ 08854.*

NEVER SAY DIE

Continued from page 53

I can see why the manufacturers aren't bothering to exhibit at many hamfests—there's no way to really cover a product's features and benefits in the usual minute or two a ham stops by a booth. I've attended a couple of in-depth product demonstrations and I'll tell you, by the time they're through I'm pawing the ground to buy the rig. Hey, I *want* to be sold. One of the most exciting things in our hobby is buying or building something new and putting it on the air.

Think. Write.

Speed

Are you doddering along with a 14.4 modem on the Internet while the rest of the world is running 28.8 and even 33.6? Okay Buster, then how are you doing on packet? Blazing along at 33.6 yet? D-u-u-h? Sure, on the HF bands, where you have to deal with multipath and fading, speeding up presents some interesting challenges. But up on VHF and UHF? Give me a break!

An ISDN line provides 56K, and some new fiber lines are offering 1,544K. The question is, how far are we amateurs going to lag behind commercial technology? Heck, I'm old enough to remember when hams led technology instead of trailing it by an ever-widening gap. But I also am old enough to remember the nasty fight to replace spark with CW, and stabilized rigs on 2m. Now we're seeing the fight to retain 5 wpm CW in the face of 1,544,000 bps communications systems.

I'd sure like to see some articles on faster packet systems, both for VHF and HF.

The challenges for faster packet on HF call for some creativity. Diversity systems? Spread spectrum? Multi-frequency transmitters? What'll it take? Some of our very weak signal CW techniques might help here. Bill Ashby K2TKN, where are you when we need you? And what a shame that Sam Harris W1FZJ smoked so much.

If we're not going to lose the race to the Internet we've got to get packet up to speed.

Half Our Population

What country with half our population has over three times as many licensed hams? Yep, it's the same country that's been whupping our ass in electronics ever since they took the lead in licensed hams. The latest issue of the JARL magazine runs 452 pages and it's packed with construction projects.

But most awe-inspiring for me are the hundreds of pictures (in color) of ham groups they publish every month. When I look more closely I can see that most of these hams are youngsters. This is the way amateur radio was when I got involved in the 1930s. In those days, as I recall, the average ham age was 28. No wonder 80% of us

Continued on page 69

Number 55 on your Feedback card

BARTER 'N' BUY

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

The deadline for the May 1997 classified ad section is March 12th, 1997.

Number 56 on your Feedback card

Above & Beyond

Antenna Construction for VHF/UHF

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119
clhough@aol.com

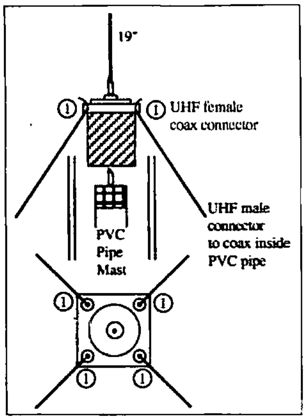


Fig. 1. Basic ground plane antenna for two meters. "1" = (4) 19" radials soldered at approximately 45° angle.

I thought that I would give some attention to simple antennas that can be constructed for our VHF/UHF bands. In a future column I will go into several other commonly-used antennas and pass on some construction techniques that I have used—but let's start out with the most basic, simple-to-construct antenna. I'll describe several methods of construction and then move on to the antenna testing vehicle, the SWR bridge that is used to adjust these antennas for optimum performance.

First let's get into some very basic structures and cover the simplest of all antennas for VHF operation—the ground plane antenna. This antenna has been the main performer for many stations, including SWL listeners in the VHF frequency ranges. The prime reason for the ground plane antenna's popularity is that it can be constructed out of common hardware store materials, at a very low cost. The basic ground plane antenna is not a gain antenna. It's a basic zero gain device.

There are several construction variations of the ground plane antenna. Let's start with the basic model. This can be built from a UHF female coax connector and five pieces of #12 electrical wire with or without the insulation. Fabricating the antenna is very simple. Cut the #12 wire to a 19-inch length for the main element and 19 1/2 inches for each of the four radial elements.

Each of the four radials is inserted into one of the four bolt holes in the UHF coax connector by bending them through and over the bolt hole. Each element is then soldered to make a firm connection to the ground portion of the connector. With the coax connector upside down (center connection pointing up), bend the four elements downward to a 45-degree angle (approximately). Then solder the fifth element (19-inch) to the top center connection of the coax connector to complete the antenna.

Keep it simple

Mounting the antenna is made simple by using a three-foot section of PVC pipe. The pipe, with the coax running through its center, is used to support the bottom section of the UHF connector. Two muffler clamps can be used to attach the PVC pipe to an antenna mast. The weight of the coax naturally holds the ground plane antenna in place. You can strengthen the #12 wire used as the vertical element by cutting a small round insulator and drilling a hole to fit the #12 wire.

Ream out a small clearance on one side of this insulator material to fit over the center connector pin of the female UHF connector. Secure in place with a silicon RTV. This short section will help to relieve strain on the solder connection of the vertical element. See **Fig. 1** for details on the basic ground plane element—the picture tells the whole story.

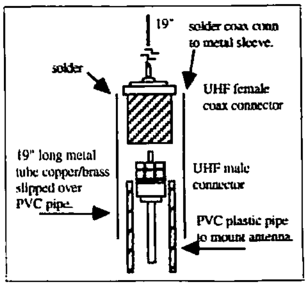


Fig. 2. Simplest two-meter ground plane sleeve design.

OK, now

You've got your antenna; you want to find out how well it matches to the frequency range at which you expected it to function. With the ground plane antenna it is almost assured that it will function well at 146 MHz. There are several methods to prove that it will function well at 146 MHz or your designed frequency.

One is to use your transmitter and an SWR bridge. This can require two people; one to operate the transmitter, and the other to adjust the antenna. Those two people could use handhelds to communicate as the antenna is trimmed for best minimum SWR on reflected power, a method that works well but may not always be convenient.

You could, alternatively, mount the antenna on a temporary test ladder over your lawn area and then adjust the length and angle of the radials for minimum SWR readings on the SWR bridge.

Another method is to purchase a commercial SWR analyzer (MFJ makes one covering 1.8 to 174 MHz, their MFJ-259). A little hand instrument replaces the transmitter and uses a internal source, which can be attached to the antenna, allowing a one-instrument test configuration to trim antennas to minimum reflection or best SWR ratio. I picked one up, and after many years of using the transmitter SWR meter method I find this instrument to be the best method available for HF through VHF.

Operation is so simple it's a snap to adjust almost any antenna to proper match—I wonder how I got along without one for so long! An added bonus is that if you make a gross error in calculations for home-brew antennas

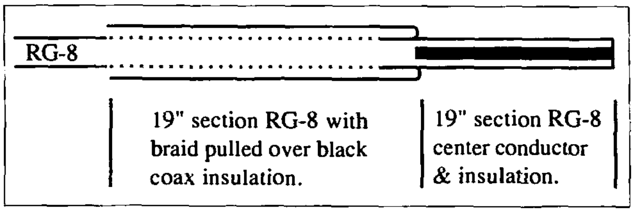


Fig. 3. *Easiest, yet most rigid, two-meter antenna to construct with minimum parts.*

and don't find a good SWR in the amateur bands, the MFJ-259 is not restricted to amateur frequencies and will tell you how far out of band your adjustment is. This makes it quite simple to know where you are resonant and what needs to be done to bring it into the amateur bands. You know right off the bat if you need to lengthen or shorten elements at your desired resonant frequency.

The basic ground plane antenna for two-meter operation works well for SWL receiving operation from 100 to 174 MHz, transmitting throughout the two-meter band with less than 1.5 to 1 SWR. Cost of construction of this antenna for two meters is about $3 and it is a very forgiving, easy-to-duplicate antenna.

The next generation

The ground plane sleeve antenna uses a metallic sleeve over the coax in place of the four radial ground elements. This metallic sleeve acts in much the same manner as the previous example's four elements and is the ground opposition to the radiating element. Electrically both antennas are quite similar even although they do not look alike.

The top or vertical element remains the same. The sleeve is soldered to the bottom side of the coax connector and is the same length as the vertical radiating element. The coax runs through the inside of the copper pipe and it is placed on a short section of PVC plastic pipe to mount the antenna. The copper pipe is connected to the same ground portion of the coax connector that the radials previously were connected to. See **Fig. 2** for details.

Going solo

The third variation of the ground plane antenna is to make the antenna out of a section of RG-8 coax by itself. This is the easiest and most quickly constructed antenna you will ever see, at least for two meters. At one end of your RG-8 cable, strip and remove about 22 to 25 inches of the outer black insulation (depending on your brand and the thickness of the insulation jacket).

I advise going long as you can always cut back on the length of braid when finished. When this length of outer insulation is removed, slowly fold back the ground braid over itself and down on over the remaining black outer insulation. It's a little tricky at first but it will go on with a little adjustment here and there.

What you want to end up with is the braid extended backwards over the insulation for a distance of 19 inches. If it's too long, cut to a 19-inch length. The center conductor and its inner insulation remain, and are also trimmed to 19 inches, for our starting point. Use the SWR bridge to adjust to precise frequency. When you have trimmed or adjusted the length of braid to your selected two-meter frequency, wrap the braid in electrical tape to hold the length adjustment you made in tuning.

If you don't tune the antenna, it will work quite well at two meters as is. Keep in mind it's not perfect—but very close. The entire antenna (modified RG-8 section) is inserted in a section of 1/2-inch PVC pipe long enough to fit the antenna and give some room to use mounting clamps below the braid. See **Fig. 3** for details.

I recommend leaving at least a foot or two of unmodified coax below the bottom of the braid before attaching mounting clamps to the PVC pipe. This helps to avoid interference from the main mast and the antenna. Use a PVC cap on top to waterproof the antenna, and on the bottom cut a small notch to allow the RG-8 to exit the side of the PVC pipe just above the bottom connector. Nothing is critical in construction or in how you run the coax through the PVC. Use any method you like to hold the cable inside the PVC pipe—after all, you don't want it to slip out.

The MFJ-259

A little horn-tooting about the MFJ-259, which I mentioned earlier. It places a small RF signal generator, with frequency counter, SWR meter, and antenna resistance meter all in one small battery-operated package. For instance, it can generate a test signal (taking the place of the transmitter), read the frequency on a internal frequency counter, indicate minimum SWR and display this frequency. It also tells you what your RF resistance is, at the RF frequency. Operation is a two-knob operation. One knob sets the frequency range and the other controls the frequency fine tuning. Simply adjust the fine-tuning knob and look for minimum SWR and 50 ohms of resistance.

This little device is quite a good adjunct for any station. I tested my unit by placing various loads and conditions of known and unknown impedances; it passed all with flying colors—and one knob/one switch operation, on the 1.8 MHz to 170 MHz frequency ranges in six bands of operation.

To test the unit for accuracy, I used several different loads, including a few very reactive complex ones, in addition to perfect terminations at 50, 75 and 100 ohms to test the resistance meter and SWR meter basic operation. Using the perfect resistance loads the SWR meter indicated near-perfect 1:1 SWR and 50 ohms RF resistance on all frequencies with the 50 ohm load. Indication was 2:1 SWR and 75 ohms RF-resistance with pure 75 ohms and 3:1 SWR and 100 ohms RF resistance

with the pure resistance of 100 ohms. Testing with proven external antennas at 7.3, 4, 14.3, 29.3, 50.1 and 146.5 MHz gave me exactly the results I had expected on six and two meters—and showed me that my inverted "V" on 80 and 40 meters was not in true resonance and RF resistance at 50 ohms.

My dipole for 10 meters was not exactly on the correct center frequency, as it was 200 kHz higher than where I wanted it—not exactly the information I wanted to hear about my existing antenna farm. I removed all the suspect antennas, performed repairs and made adjustments with the analyzer. I found a broken, half-missing ferrite core transformer (balun) and 20% of the 80 meter loading coil was shorted. I repaired the balun, rewound both 80 meter loading coils, and retested the antennas. Retesting the 80 and 40 meter antennas showed good SWR and 50 ohms RF resistance at their (previously set) proper frequencies.

Now that I have climbed back down from my roof and finished with the short antenna project that turned into a all-day repair job, I am only more convinced of the value of the MFJ-259 or at least of leaving a good SWR meter in the line at all times to spot defects. By tuning the MFJ analyzer I did not have to use a transmitter to perform tests on antenna conditions, and the portable unit worked flawlessly.

I started to verify short antennas, namely, my vast collection of "rubber duckies" for six and two meters, and found a few two meter units better suited for FAA use in the aircraft band, as they were resonant in the 120 MHz range. Pulling the black cap off the end of the antenna, removing a few coil turns, and retesting on the analyzer returned resonance to the 146 MHz frequency range. Again, I had never tested my rubber duckies, and have even interchanged them among the myriad of HTs I have owned. All I can say is that after resetting them to frequency and minimum SWR, HT operation *is* somewhat improved.

Coming up

What started out to be a simple article on two meter antennas has given me a new perspective on, and respect for, the MFJ-259 SWR bridge/signal generator. I am already thinking about some interesting additional features and sidecar attachments to make this device more useful than it already is—I will explore the possibilities further in another column. I had hoped to cover some "J" antennas and beam antenna construction for two meters and above, but I will pick that up next month.

I have started construction of a 432 beam antenna. The comparison I wish to draw is to the cost of commercial ready-to-use vs. home-brew construction. I plan to keep track of all efforts to locate materials and the costs accumulated in the beam antenna construction project. I anticipate a lot of fun in trying to convert myself, a workbench rosin addict, into a junior-grade machinist. More next month on antennas for VHF and UHF, and the dangers of the drill press. 73

Number 58 on your Feedback card

HOMING IN

Homing In Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92637

Testing N6BG's PicCon

"I need a fox!" That's one of the most common requests in my E-mail in-basket. It also shows up regularly on the Internet mailing list for radio direction finding (RDF) enthusiasts. Usually the requester has just won his first hidden transmitter hunt, which might be called a T-hunt or foxhunt, depending on where he lives. He is looking for a transmitting device because it's now his turn to hide for the next hunt.

A special "fox box" isn't always a necessity. For some hunts, all you need to do is find an unusual spot, set up a portable transmitter/antenna, and yak into the mike at intervals called for by the hunt rules. But it's more fun when you automate the process. An unattended fox (or "T") frees you to move around, drawing attention away from the transmitter's location. You can enjoy the spectacle of the hunters scurrying to locate it. It saves your voice, too. The easiest audio source for this purpose is an endless loop tape recording. Unfortunately, cassette decks don't fare well outdoors during damp evenings and they don't have provision to cycle the T on and off.

"Want to bury your T on Thursday and have it come on at hunt time on Saturday?"

Mobile T-hunts around the country have an endless variety of rules, calling for transmissions ranging from a few seconds every few minutes to continuous. On the other hand, championship on-foot foxhunts under International Amateur Radio Union (IARU) rules require several synchronized fox transmitters sending a prescribed CW message for 60 seconds each in numbered sequence.

The optimum solution for most hunts is a device with no moving parts that provides distinctive audio and versatile on/off cycling for ordinary portable and handheld transceivers. Several designs for such fox controllers have appeared in recent years, but none has been ideal for both mobile and international-rules hunts, until now.

Byon's new baby

Byon Garrabrant N6BG (formerly KD6BCH) is a software engineer and an active T-hunter (**Photo A**). He teamed up with Marty Mitchell N6ZAV to create the RaCon 6805 three years ago (see "Homing In" for July 1993). RaCon (short for Radio Controller) uses an MC68HC705C8 microcontroller IC and supporting circuits. It outputs several built-in tone sequences and timing choices plus a user-programmable sequence. CW identification is included too, of course.

RaCon became quite popular among T-hunters in Southern California, but Byon wanted something better. When PIC microcontrollers became inexpensive, he realized that one could be the brains of a fox controller that would be much smaller, cheaper, and easier on batteries. Byon chose the PIC16F84 by Microchip Technology Incorporated of Chandler, Arizona, which uses flash memory for the program and a electrically erasable PROM for data retention.

Byon polled local T-hunters for ideas for the ideal fox box. They asked for non-volatile memory, fully programmable transmit on/off timing, and a delay feature to start transmissions automatically at hunt time. The ability to change programming from a remote location during the hunt was also desirable. I suggested adding timing and CW transmissions in accordance with IARU rules for international foxhunts, plus provisions for easy synchronization of multiple foxes for championship competitions.

Before long, Byon emerged from his shop and passed out beta test kits to eight regular RDFers. Every tester met with success, only minor revisions were needed, and PicCon (pronounced "PICK-on") was born.

An easy kit

Byon says PicCon takes less than 30 minutes to assemble. He's right. There are no surface-mount parts (good!). However, you will need a fine-point soldering iron because the parts are packed onto the 1-7/8-inch by 1-3/4-inch circuit board (**Photo B**). The board is high quality, single-layer, with solder mask. All parts for the board and a RJ25 output cable are supplied. You must supply your own connectors for the mike, speaker and push-to-talk (PTT) lines of the transmitter you will be using for your hidden T.

If you're like me, it will take more than another half hour to figure out all the intricacies of programming your PicCon. The unit is so versatile that it took

Photo A. PicCon designer Byon Garrabrant N6BG likes both mobile T-hunting and international-style foxhunting. He had the best score out of 27 entrants at the 1996 West Coast VHF/UHF Conference Foxhunt.

several read-throughs of the beta test manual. (The new Version 1.0 manual is easier to understand.)

When you first activate a new PicCon, it sends a pre-programmed 3-second tone sequence over and over for 30 seconds and then identifies in CW with the software version number. Your first task is to change the CW message to your callsign and set the transmission on and off times as appropriate for your local hunts. You do this by sending DTMF commands to the fox transceiver connected to PicCon using another radio that transmits on the frequency where the fox rig is listening.

As an example, the DTMF sequence A20130 tells PicCon that tone sequences are to last for one minute and 30 seconds each. Program your callsign in a similar manner by sending numbers representing the letters and numbers in the call per the "cheat sheet" in the manual. Each command is stored into the PIC's EEPROM, so the information is not lost when the unit is powered down.

Upon application of power, PicCon waits silently. A DTMF command or push of the momentary switch on the board starts the transmission sequences. Alternately, you can program the board to begin transmitting immediately upon power up. To ensure that only you are in control of your transmitter, PicCon has a lock command. When you lock it, you enter a private numerical code that you will send to unlock it later.

Next, you can get fancy by designing your own tone sequence. You have 99 tone pitches to choose from and the sequence can have up to 28 tones before repeating. The speed of the tone sequence is programmable, as is the speed of the CW ID. You can even program a repeating 8-event series of tone sequences, off times, and IDs.

Want to bury your T on Thursday and have it come on at hunt time on Saturday? One DTMF command lets you specify a delay of up to 100 hours before the first transmission. If the hunt must end at a certain time, another command will terminate all transmissions after a pre-programmed duration.

If you use a single-band transceiver with PicCon, don't program continuous transmissions if you need remote control during the hunt. Set up at least a short receive period every few minutes. If your fox rig is a dual-band transceiver with duplex capability, you can control PicCon via one band while it transmits simultaneously on the other band.

PicCon includes a 78L05 voltage regulator and operates from a DC supply of 7 to 35 volts. It draws only 12 milliamperes, so an ordinary 9-volt alkaline battery will power it for over 24 hours. If you disable the LED via a DTMF command, current drain is only 9 mA. Even when battery voltage plummets, PicCon won't go berserk. The CMOS microcontroller is tolerant of low supply voltage. My unit worked down to 3.5 volts, though audio level diminished somewhat below 6.5 volts.

IARU mode, too

PicCon makes it easy to field up to nine foxes for radio-orienteering (ARDF) competitions. You'll need one PicCon and one transceiver for each. With a DTMF mode change command, fox #1 sends "MOE" over and over in CW. Fox #2 sends "MOI," fox #3 sends "MOS" and so forth, in accordance with IARU rules.

With other commands, you can set PicCon to send the MO sequence for 55 seconds at 5 wpm, then callsign in CW at 20 wpm, then shut off so the next fox can transmit. Program into each fox the appropriate wait time before first transmission, then start them all at once using the on-board push-buttons or a DTMF command. The foxes will cycle in perfect sequence for the duration of the hunt.

For IARU championship foxhunts on 80 meters, on/off CW is used instead of tone modulation. PicCon provides a separate 80-meter mode that keys CW transmitters via the PTT output line. There are several other useful options such as random tone sequences and rates that you can read about by downloading the latest PicCon User's Manual from Byon's Web site. Go to URL http://www.kvoa.com/byon/piccon/ or get there via the link from my "Homing In" site.

I couldn't find any faults or bugs in the PicCon hardware or firmware, but it has a few limitations. The repeater mode that was in RaCon is not in PicCon. To minimize current drain, the PTT drive transistor is small and lightly driven. You won't have any trouble keying a handie-talkie, but older mobile radios with high current PTT relays are too much load for it. So are the stamp-sized micro-Ts that have been described previously in this column. However, it's easy to solder up simple adapters with one or two transistors to key these rigs.

Byon has packed lots of features into the 1,024 words of firmware memory in the microcontroller. That didn't leave enough memory space to include error-trapping routines. If you enter an undefined command or parameters that are outside the specified range, PicCon will react in an unpredictable manner. Fortunately, there is an easy procedure to reset the EEPROM that

you can use to bail out and start over if you program yourself into a corner.

Other than listening and checking with a stopwatch, there's no way to verify the timing you have programmed with DTMF. The LED on the board flashes at various rates to indicate power turn-on initialization, DTMF being received, waiting for completion of a command, and PTT activated.

meters," he writes. "The hotel was first class. Food and drink were very cheap by our standards.

"Coffee was 25 cents and beer 40 cents in the lounge," Wally continues. "At a roadside cafe, the dearest (most expensive) item on the menu was steak and chips at one dollar US currency. The courses for the events were well selected and ranged over the undulating countryside, either open

"The only casualty was a DL (German ham) who was bitten on the leg by a farm dog."

PicCon kits are available for $49 each plus $2 for shipping/handling from Byon Garrabrant N6BG, 1150 N. Harding Street, Orange CA 92867. There is a 10% discount for purchases of three or more PicCons. Built/tested/packaged units are not available at this writing, but may be in the future. N6BG's E-mail address for inquiries is: byon@netcom.com and his phone is (714) 538-0203, evenings only.

News from Down Under

Thanks to editor Wally Watkins VK4DO for sending a copy of *Radio Sport News* from Australia. In this publication, Wally reports that the European ARDF championships in Bulgaria were a huge success. Nineteen countries took part. "The location was a ski resort in the mountains south of Sofia at an elevation of 1300

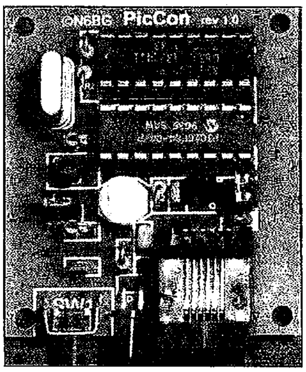


***Photo B**. This little circuit board plus a 9-volt battery and a transmitter/antenna are all you need to make a hidden transmitter for a mobile T-hunt or on-foot foxhunt.*

or heavily timbered by pine plantations. On both days, there was one steep hill to climb. The only casualty was a DL (German ham) who was bitten on the leg by a farm dog."

The first New Zealand national ARDF Championships will be March 28 through 31, 1997 in Christchurch. Separate events will be staged with 80-meter CW and two-meter AM foxes. The 1997 Friendship Radiosport Games in Kanagawa Prefecture, a suburb of Tokyo, Japan, from August 18 through 25 will include a championship radio-orienteering contest on two meters.

The next ARDF World Championships will be in Germany at St. Engelmar ski resort in the mountains near the Czech border. The World Championships after that will be held in IARU Region 3 in the year 2000. Australia is the prime candidate host country for that meet, because it could be held just before or just after the Olympic Games there.

If you are interested in attending any of these international ARDF events, write to me and I will try to put you in contact with the organizers. Send E-mail to: Homingin@aol.com or postal mail to the address at the beginning of this article. Also be sure to check the "Homing In" Web site (http://members.aol.com/homingin/) for current ARDF news. You'll also find lots of information on how to get started in both international-style on-foot foxhunting and American-style mobile T-hunting. 73

Number 60 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

Satellites made easy

One visit to a satellite enthusiast's station or a look at photos of ham-radio satellite stations gives the impression that it takes a lot of gear to get on the air via the OSCARs (Orbiting Satellite Carrying Amateur Radio). In many cases it can be expensive and complex to chase the satellites. There are several that are either very high tech or use uncommon frequencies requiring specialized equipment. Fortunately there are other satellites of a simpler nature.

The Mode A (two meters up and 10 meters down) satellites like the RS series used to be the satellites of choice for beginners and portable operators. These satellites have been called "EZ-sats." All that is required is a two-meter transmitter capable of CW or SSB at a reasonable power level (10 to 25 watts) with a ground-plane

about AMRAD can be found at their Internet URL (Universal Resource Locator) http://www.amrad.org.

Launched on September 26, 1993, the satellite has performed well in its circular 800-km high orbit. It is a nine-inch cube weighing about 20 pounds with a single whip antenna for two-meter reception on top and four 70-cm downlink antennas on the bottom. While the amateur-radio segment of the satellite was designed to provide digital communications from 300 to 9600 baud, the favorite mode has been the analog FM "bent pipe."

A-O-27's "bent pipe" acts as a flying crossband FM repeater. The uplink is on 145.850 MHz with a downlink on 436.800 MHz. The repeater is usually on for daylight passes over North America. Many stations have made contacts through the transponder with simple home stations, mobile setups and even portable systems.

"Except for the antenna and the charger, everything fit in a small, soft-sided camera case."

antenna and a ten-meter receiver hooked to a dipole. A few magmount antennas even allow mobile operation.

New devices have been placed in orbit that have changed the definition of the "EZ-sat." AMRAD-OSCAR-27 (also known as EYESAT-A) is the best example.

A-O-27/Eyesat-A is based on the AMSAT (Radio Amateur Satellite Corporation) microsat design. The satellite was built by Interferometrics, Inc., as a commercial demonstration of the capabilities of a small satellite for digital store-and-forward communications. The amateur-radio portions of the satellite were built by the Amateur Radio Research and Development Corporation (AMRAD), a technology-oriented amateur radio club near Washington, DC. More information

The two-meter receiver on A-O-27 is quite sensitive. The casual user may disagree, however, based on personal observations during a typical pass. Since A-O-27 offers only one FM channel, it is like a repeater with too many users all trying to talk at once. Even weekday passes during work hours can be congested. For a low-power station using simple antennas, persistence, location and cooperation from the other users are necessary conditions to make contacts. Most of the regulars on A-O-27 are aware of the problems and try to give the newcomer or low-power operator a chance.

On vacation

I recently had the opportunity to take a week off with the family. Some great rates on a cruise

Photo A. Back on land with a Yaesu dual-band HT and Mirage dual-band amplifier for mobile/portable A-O-27 operation.

to the Caribbean, good timing, and an enthusiastic crew, kids and wife included, decided the issue.

My wife Heather WB5RMA asked if I would be taking any radios. At first I thought it would be too inconvenient on a cruise, but after listening to a talk about portable operation by Ray Soifer W2RS at the AMSAT Space Symposium in Tucson, I decided to put together a small portable satellite station. Ray used a Kenwood TH-26AT hand-held transceiver for CW uplink to RS-10 and a Sony SW-100E miniature portable shortwave receiver for the ten-meter downlink. Details on his activity can be found in the November/December 1995 issue of *The AMSAT Journal*. His article is called "The World's Smallest Satellite Station?" I started planning for an even smaller setup.

I've been on a lot of boats and offshore drilling rigs during my years in Gulf of Mexico offshore field work. I used to listen to AMSAT-OSCAR-7 with a two-meter, all-mode rig and a ground plane antenna during down time on the rigs. Once I even got a visual sighting of A-O-7 when conditions were right.

Radio frequency noise was usually not a problem for VHF reception. Although there are a lot of potential noise sources on the man-made islands, the higher frequencies are not as susceptible as the shortwave bands. Attempts to receive ten-meter satellite signals were usually not worth the trouble.

While Ray could get away from most noise sources with his simple station, I could not. The cruise ship, with its generators, lights and electric motors, could be quite a problem for my simple Grundig YB 400 shortwave receiver.

The station

To save on space and keep things light, I tried my Alinco DJ-580T dual-band HT on a good A-O-27 pass before setting sail. The downlink on 436.800 MHz FM was good, but competition on the 145.850 MHz FM uplink was fierce. A brief contact was made,

> ***"Those dual-band HTs are good for a lot more than just talking to someone on the other side of town."***

but a few station improvements were needed.

A Diamond RH778 dual-band antenna (15 inches long) was loaded in the suitcase along with an external Alinco microphone, an E.H. Yost 1000 mAh, nickel-metal hydride 12-volt battery pack (model EBP-22nh), a small wall charger, a Garmin GPS-45 receiver and some stereo ear-bud headphones. The antenna and high-voltage battery provided a better uplink signal, while the phones and microphone allowed easier orientation of the HT for best signal during a pass. Except for the antenna and the charger, everything fit in a small, soft-sided camera case.

Rather than take along a laptop computer to make predictions, I plotted out orbit listings on paper at home, based on the cruise

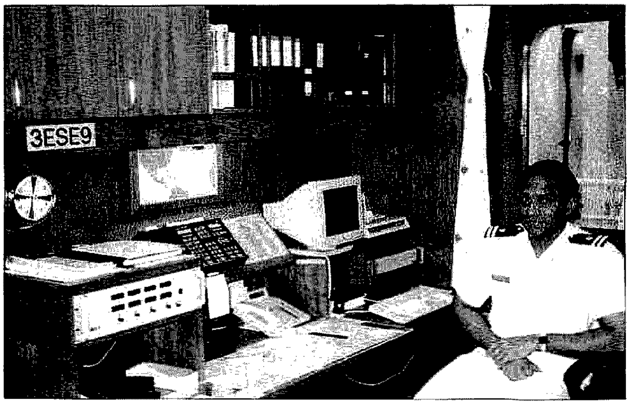


Photo B. No CW keys or spark-gap transmitters in the ship's radio room.

itinerary. Since I would not be trying to use directional antennas, prediction errors derived from approximate locations would not be a problem. Latitudes and longitudes for Miami, San Juan, St. Thomas, Sint Maarten/St. Martin and points in between were used. Only daylight passes for A-O-27 were printed.

The list was a bit short, so I included predictions for the *Mir* space station. The onboard, 70-cm repeater has been activated and available for use almost every time I have listened. Although the Doppler shift has been a challenge, downlink signals are quite readable. The repeater uplink is on 435.750 MHz FM, and the downlink is 437.950 MHz FM. A CTCSS (PL) tone of 141.3 Hz is required to access the system. More information on the *Mir* repeater and the history of ham activities on *Mir* can be found in the October 1996 "Hamsats" column.

Licensing issues

At some point it occurred to me that I might need to consider the potential legal ramifications of my maritime-mobile operation. With the exception of Sint Maarten/St. Martin, all the ports were U.S. Rather than try for a license on the Dutch/French island, I decided to be a good tourist that day, and just see the sights.

Our cruise ship, the Carnival *Sensation*, is registered in Panama, so I checked with the ship's radio operator about my potential ham activity when I got on board. After a brief explanation of what I had in mind, the operator's only concern was for my activities on land and the few HF and VHF frequencies that the ship used for port communications and emergency activity. Apparently my VHF/UHF ham activities would not be a problem. The operator was fascinated by the fact that I would be using a small HT and whip antenna to attempt satellite contacts.

Photo C. WA5ZIB on deck, getting ready for AMSAT-OSCAR-27.

The equipment in the ship's radio room included a few control panels and two personal computers. The ship's HF distress frequency was 2182 kHz and the two VHF-FM frequencies to avoid were 156.525 and 156.800 MHz. Everything else onboard used geostationary satellites. The automatically-steered satellite dishes on the ship were encased in weather radomes and were quite impressive. I was assured that there were no spark-gap transmitters or CW keys in use. Telephone rates to the U.S. were about $5.00 per minute via the satellite links.

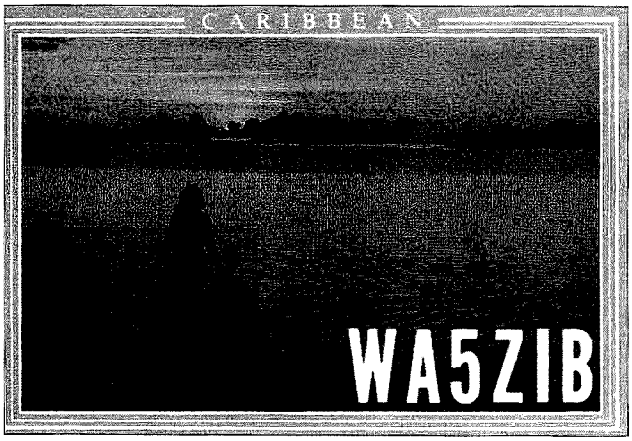


Photo D. The WA5ZIB QSL card for A-O-27 contacts made during the cruise.

The results

One of the less-populated sun decks became my "ham shack." While there were plenty of activities on board ship, there were also plenty of leisure moments. The Garmin GPS-45 receiver made a good paperweight for the orbit listings while the HT was configured for A-O-27 or *Mir* repeater operation. During the cruise several contacts were made with stations from Vermont to Texas via A-O-27. Each time I made a contact, I marked the position in the GPS (Global Positioning System) receiver. Many of the A-O-27 operators collect grid squares, and it was also a fun exercise to keep up with the ship's progress. I even had a visitor in "the shack." Frank WØAJY and his wife Nancy noticed my operation and came by to say hello and discuss ham activity and the computerized ship's radio room. While in port, family activities took priority.

I tried a few Puerto Rico and St. Thomas repeaters, but it wasn't nearly as exciting as the satellite contacts with the HT. Results with the *Mir* repeater, however, were disappointing. While I could key the repeater with the HT and short antenna, few stations were heard and no contacts were made. To properly track *Mir*, recent orbital element data is needed, and due to the 70-cm uplink and downlink, it's not possible to operate full duplex. The necessity for significant Doppler correction to stay in the repeater passband and the apparent lack of sensitivity in the repeater's receiver makes operation via this system more difficult.

Back on land

Taking satellite operation along on the family vacation turned out to be a lot of fun. I wasn't on a DXpedition and I didn't make that many contacts. It was just an entertaining experiment for those moments that would have gone to waste in front of a TV or a gaming table in the casino.

Since the cruise I have noticed other stations trying out HTs and mobile rigs on A-O-27. Many have been doing this for quite a

Letters

Continued from page 7

Internet through our home page (http://www.feist.com/~aa0of).

You can breathe a sigh of relief, Wayne, because my teaching methods would please you. My students are given numerous opportunities to experiment and discover. The basis, of course, is amateur radio, but their imaginations are free to create and design.

Wayne, the Andover Schools Amateur Radio Club would like to extend you an invitation to come and visit us. I think you'd be proud.

Hmm, maybe I'll get invited to a Wichita hamfest and have a chance to meet your students. I hope so... Wayne.

Fred Ordway KI6QK: I'm the Official Observer Coordinator for the ARRL Los Angeles Section. I believe that the OO program has been designed for failure. It is a stalling and pass the buck vehicle for the local FCC engineers-in-charge. The system fails because the FCC does not enforce the rules.

Now the ARRL in its meddling (by a radio club that represents less than 20% of amateur radio operators) is pushing its way into the regulatory process with National Repeater Coordination.

If you look at the amount of amateur radio spectrum that's available for coordination you'll see that in the three main VHF/UHF bands approximately 66% is subject to coordination.

Many of the coordination groups are made up of the Good-Old-Boy network. They started their own frequency coordination group to meet their special interests. They do not represent the amateur community and tend to protect their own self-interests. When an amateur has to pay membership to belong to a frequency coordination group to get his repeater coordinated, and only coordinated repeaters may vote for the officers and rules, it is obvious that the program is a sham.

Part 97 and specifically §97.101(b) states... "No frequency will be assigned for the exclusive use of any station." The FCC has made the regulations so that everyone can participate in the hobby. §97.205(a) says that any amateur station licensed to a holder of a Technician, General, Advanced or Extra Class operator license may be a repeater.

Now the ARRL and the frequency coordinators that are made up of repeater owners are attempting to gain a vehicle to maintain their status quo and deny or attempt to deny others full participation.

I urge everyone to study the ARRL and National Frequency Coordinators proposals to see how a private group will take away our rights and limit our participation in the hobby. This is bad for amateur radio. The ARRL must be stopped.

If coordination could be done the way GMRS repeaters are licensed, there would be no problem and no one would be denied. On the GMRS channels it is only a matter of filling out the papers and writing a check. Everyone is on the a level playing field. If the ARRL gets its way there will be no level playing field, only a continuation of a system of corruption, bribes and favoritism. If you are not in the clique, you can lose.

The band plans are established for everyone and that enables all of us to participate in the various areas from CW, weak signal, ATV, digital, SSB, FM and repeaters. This proposal will significantly diminish the level of participation of every amateur operator for the benefit of a few. I do not want to relinquish my freedom to a bunch of self-serving, self-appointed Good-Old-Boys (and -Girls).

Troublemaker... Wayne.

Carlton Davis NQ3Y. I read Marshall Emm's review of the Green Mountain 20 Meter CW QRP transceiver in the June '96 issue. The review and the low price inspired me to go out and buy one from Small Wonder Labs. The kit was easy to build, but I would not recommend it to an inexperienced builder. A beginner can probably assemble the kit with the aid of a more experienced builder. I purchased the 30 meter version. 30 meters has the long range capabilities of 20 meters and the short to medium range capabilities of 40 meters. In addition, since contesting is not allowed on 30 meters, it is easier for a QRP station to have weekend rag chews without battling the kW boys. Since I check my work as I assemble, the kit went together in three evenings. It took me

Continued on page 75

while. At my office in Houston Ken KC5WXV and I have tried a few more experiments with A-O-27 during coffee breaks. Using his Yaesu FT51R dual-band HT and a Larsen dual-band mag-mount whip antenna we could easily hear activity on A-O-27, but had marginal success getting through the FM pileup to make a QSO. We then added a Mirage DD-35 dual-band amplifier and had success. The Mirage amplifier is advertised as a full-duplex unit. When using full power output on two meters (about 45 watts), we noticed some desensing of the 70-cm downlink signal from the satellite. An AOR AR-8000 scanner on a separate antenna did not exhibit any desense, but there are some issues with the power connections and ground points that may provide some cures for the single HT/amp/antenna system.

There have been complaints about the congestion on the single channel FM transponder on A-O-27, but it's in orbit, it's sensitive and it works. While we wait for the launch of Phase 3D, there's still a lot of activity via low-earth-orbit hamsats. Plot some A-O-27 orbits and listen. Those dual-band HTs are good for a lot more than just talking to someone on the other side of town.

Communications Simplified, Part 15

Antenna basics.

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

It's time to look at antennas. Although we'll look primarily at transmitting antennas, it's important to note that a good transmitting antenna will also generally work well for receiving (though not always the other way around).

The dipole antenna

Previously, we learned that a 1/4-wavelength section of transmission line that is open at the far end looks like a short at its input. Let's now take such a section of balanced line, and connect it to an RF signal generator, as at **Fig. 1a**.

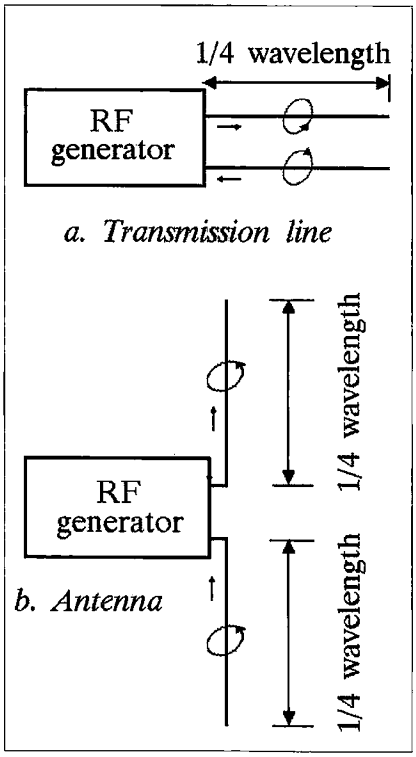


Fig. 1. A transmission line vs. an antenna.

Since the generator sees a short circuit, it is not feeding any power into the cable. That is, there is current, but no voltage; since the power is the product of current times voltage, the power leaving the generator must be zero. That makes sense, since there is no place for any power to go.

Now let's separate the two wires of the balanced line, bending them completely out so they point in opposite directions, as in **Fig. 1b**. If we now take some measurements, we will see that there is not only current flowing out of the generator, but there is also a voltage across its output. (And, for the purists among our readers, the current and voltage are in phase.) There is thus power leaving the generator and going into the wires. So where is it going?

What is happening is that, by opening up and separating the two wires, we have changed the transmission line into an antenna. The power coming out of the generator is being transmitted out into space. If we actually measured the impedance looking into the antenna of **Fig. 1b**, we would measure a resistance of about 73 ohms, rather than a short circuit. If the generator outputs the voltage V, then the power going into the antenna is

$$P = \frac{V^2}{R} = \frac{V^2}{73}$$

Look back at **Fig. 1** again. The small straight arrows along the wires show the current direction at some particular instant of time. In each case, the current on the top wire comes out of the generator, while the current in the bottom wire goes back into the generator. In the transmission line, the two currents go in opposite directions, while in the antenna, the two currents both go in the same direction—up.

These two currents both cause magnetic fields to go around the wires; these go in a circle around each wire, and are shown in **Fig. 1** as small circles, with tiny arrows indicating the direction of the magnetic field.

In the transmission line, **Fig. 1a**, the two currents go in opposite directions, and so the two magnetic fields also go in opposite directions. Moreover, the two currents are equal, so the two magnetic fields are also equal. So they cancel. That is, if you were to stand a few feet away from the wires, you couldn't measure any magnetic field because the two cancel.

In the antenna, however, the currents in the two wires always go in the same direction. Hence the magnetic fields also go in the same direction. So, if you were to stand back a few feet, you would be able to detect the magnetic fields (if you have sensitive enough equipment) because they add, rather than cancel.

In addition to generating a magnetic field, the antenna wires also generate an electric field.

DETOUR

The concept of a *field* is hard to explain, yet important for us to understand. In simple terms, a field is a system of forces filling some space, which can cause something to move. An analogy is the wind in a storm. At any particular spot, the wind has a certain strength and a direction. If you let a balloon loose at that spot, the wind will move it. How fast it moves depends on the strength of

the wind (field) at that spot, and the direction it moves depends on the direction of the wind (field) at that spot. Moreover, as it moves from one place to another, the balloon may change its motion because the field at the new location may have a different strength and direction.

The current through the wires causes a magnetic field which, at any particular spot in space, has a certain strength and a certain direction. **Fig. 1** doesn't show the strength, but the arrows on the circles show the direction. If you place a compass on the field, the arrow shows which way the compass would point.

We can also generate an electric field, in a different way. Suppose we have two metal balls, as in **Fig. 2**, and place a lot of negative charges (electrons) on the top ball, and a lot of positive charges (protons) on the bottom ball, as shown. If you now place a single electron at the spot labeled "A," that electron will move (assuming there's nothing in its way). The famous rule in electricity is that "Unlike charges attract, while like charges repel each other." The protons on the bottom ball will attract the lone electron, while the electrons on the top ball will repel it, so the electron will move down, in the direction of the arrow. So the charges on the two metal balls generate a field which can cause that electron to move.

In the same way, electron B will move down and to the left, also in the direction of the arrow, and electron C will also move in the direction shown by the arrow. The thin curved lines going through electrons B and C show the direction of that field—the path that the electron would take. We could draw an entire series of lines in **Fig. 2**, which would show the path an electron would take if dropped anywhere in the space around the two balls. These lines would then specify the direction of the field.

END OF DETOUR

So let's take another look at the antenna shown in **Fig. 3**. Imagine that the small arrows along the wires indicate the flow of electrons along the wires. Electrons flow up on the top wire, eventually generating an excess of electrons at its

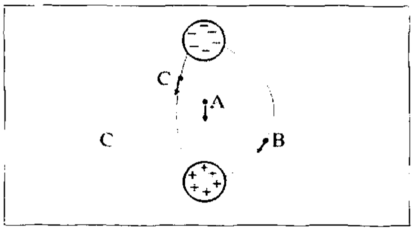


Fig. 2. An electric field.

tip. At the same time, electrons flowing upward on the lower wire leave a lack of electrons—or an extra number of protons—at the end of the bottom wire. So we now have a negative charge at the top, and a positive charge at the bottom. This generates an electric field, just as the two charged balls generated in **Fig. 2**.

At the same time, the currents in the two wires generate the magnetic field, which circles the wires as shown by the arrows on the circles around the wires.

"AM broadcast stations often float their antenna towers on a raft in the middle of a swamp, since the water in the swamp makes it a good conductor."

Remember, though, that the voltage and current are constantly changing. The generator is sending out a high frequency carrier—a high frequency sine wave with some modulation on it. So both the magnetic and electric fields are constantly increasing and decreasing, and even changing direction, as the voltage changes from positive to negative and vice versa.

The next step in our explanation requires a leap of faith; it can't be justified without a lot of math. In 1873, James Clerk Maxwell published a set of equations called (surprise!) *Maxwell's Equations*, which show that the magnetic and electric fields interact. What essentially happens is that buildup and collapse of the electric field pushes the magnetic field away from the antenna; in exactly the same way, the buildup and collapse of the magnetic field pushes the electric field outward. The result is an *electromagnetic* field which radiates outward from the antenna into space, like a radio wave. This electromagnetic wave explains not just radio and TV waves, but even light, which is just another kind of electromagnetic wave, though of much higher frequency (and shorter wavelength) than even microwaves.

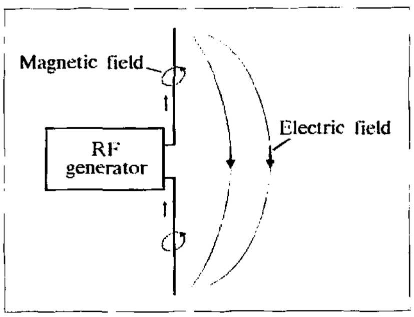


Fig. 3. Fields around a dipole.

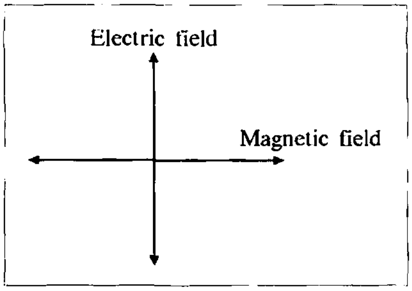


Fig. 4. Fields with vertical polarization.

In short, the two 1/4-wavelength wires in **Fig. 3** make up the simplest kind of antenna, called a *dipole*. Most dipoles, however, rather than consisting of vertical wires, are horizontal. Note that the currents in the two halves of the dipole need to be equal but opposites. The dipole therefore needs a balanced transmission line; it cannot be properly fed by a coax cable.

Antenna polarization

If you stand back from the vertical dipole antenna of **Fig. 3** and watch the electrical and magnetic fields go through space past you, because the dipole antenna goes up-down, you will note that the electric field is always up-down, while the magnetic field goes left-right, as shown in **Fig. 4**. This is called *vertical polarization*, and the antenna is *vertically polarized*. If the antenna was horizontal, then the signal would be horizontally polarized as well.

The best way to receive a vertically-polarized signal would be with another vertically-polarized antenna. The electric field will make electrons in the antenna move up and down (causing an electric current), and the magnetic field changing around the receiving antenna

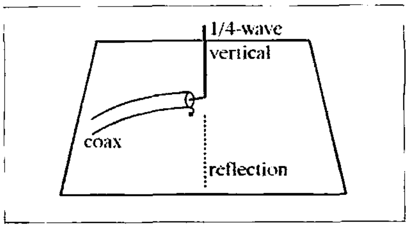


Fig. 5. The 1/4-wave vertical.

will also make electrons move up and down (also causing an electric current). If the receive antenna were horizontally polarized, then the current flow in the wire would be across the diameter of the wire, not along it, and the receiver would receive very little signal. So we need to pay some attention to the polarization of antennas. For example, most AM broadcast stations use tall towers as the antenna; these are vertical, and so a vertical antenna (like a car antenna) works well. TV stations, on the other hand, always use horizontal transmitting antennas, so you need a horizontally-polarized antenna to receive them.

Satellite communications are a problem, since satellites sometimes rotate in space, and signal polarization is also affected by traveling through the earth's atmosphere. So satellites often use *circular polarization*. This involves two antennas, one horizontal, the other vertical, positioned 1/4 wavelength behind each other, and both transmitting the same signal. The signal from the closer antenna arrives first with one kind of polarization; the signal from the other arrives 1/4 of a cycle later, but is polarized at 90 degrees from the other. So it looks as though it has turned 90 degrees. Depending on how you position the antennas, you get either right-hand or left-hand rotation.

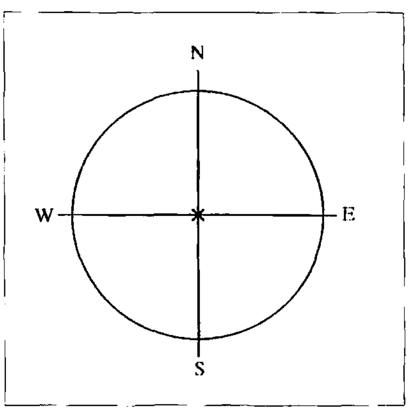


Fig. 6. Radiation pattern around a vertical dipole.

1/4-wavelength vertical antenna

A vertical antenna, such as the whip you might see on a police car, is basically half of a dipole, as shown in **Fig. 5**. Suppose you were to take just one 1/4-wavelength wire, but position it vertically above a mirror, as shown. If you then look at the wire's reflection in the mirror, you would think that there are in fact two wires—a dipole. The "mirror" under the antenna is called a *ground plane*, and it makes the vertical antenna look like a dipole.

Because radio waves reflect from a conducting surface, any large sheet of metal will act as a ground plane. So mounting a 1/4-wave whip on a metal surface, such as a car roof, works well. If a vertical antenna is mounted on the ground, it's necessary to make the ground under it more conductive so it acts as a better mirror. Commercial AM broadcast stations often float their antenna towers on a raft in the middle of a swamp, since the water in the swamp makes it a good conductor. (Incidentally, the tower doesn't actually touch the ground under it. The base of the tower sits on an insulator.) Amateur radio operators, on the other hand, often bury wires (called *radials*) in the ground around the vertical antenna. They are called radials because they spread outward from the antenna, like the radii of a circle. Radials are also needed when mounting a whip antenna on the body of a car with a Fiberglas™ body; hams often use conductive aluminum tape for that purpose.

"If you could see the three-dimensional radiation pattern, it would look like a donut."

In order to "see" a full reflection of the wire, the ground plane has to extend far enough out from the vertical antenna. It should extend at least 1/4 wavelength out in each direction, although more is better. Even so, imagine that the ground plane is, say, the length of the 1/4-wave whip. If you look at it from above, you see the reflection of the whip in the ground plane, but if you look from a shallow angle, you only see a very small part of the whip in the "mirror." Hence a vertical tends to transmit slightly upward, rather than horizontally along the ground.

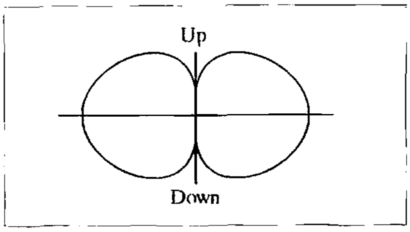


Fig. 7. Dipole vertical radiation pattern.

Since there is no bottom wire to the antenna, there is no place to connect the second wire in a balanced transmission line. Hence vertical antennas are usually fed with coax cable. The inner conductor goes to the vertical, while the outer shield connects to the ground plane just under or next to the whip. Since there is only half of a dipole, the impedance of the whip is 1/2 of the dipole's impedance, or about 37 ohms.

Radiation patterns

The term "radiation pattern" describes the directionality of an antenna. An antenna which transmits (or receives) equally in all directions is called an *isotropic antenna*. But there is no such thing—it is impossible to build one. Instead, every real antenna transmits better in some directions, and worse in others.

Consider, for example, a plain vertical dipole as shown in **Fig. 3**. You might see such an antenna, for instance, hung from a weather balloon, with the transmitter actually hanging in the middle of the antenna. Such an antenna would transmit equally well in all horizontal directions—north, south, east, and west. If you imagine that we're flying above the antenna, looking down at it, we would draw the horizontal radiation pattern as in **Fig. 6**. The small X in the middle signifies the position of the antenna, and the circle around it shows the directions in which it transmits. Because the radius of the circle is the same in all directions, the signal strength is also the same in all directions. We say that such an antenna is *omnidirectional*. (On the other hand, an ellipse which was longer north-south

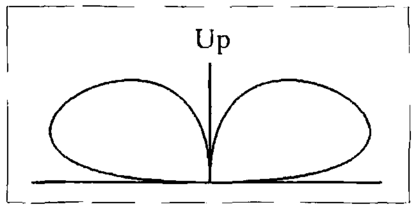


Fig. 8. 1/4-wave vertical radiation pattern.

than east-west would mean that there is more signal going north and south than east and west.)

If, on the other hand, you look at the antenna from the side, you would note that it transmits fairly well horizontally, but not at all up or down. That is because the dipole doesn't send (or receive) any signal off the ends of the wire. In this case, the vertical radiation pattern (as seen from the side) would look like the figure-8 pattern in **Fig. 7**. Since the pattern is actually three-dimensional, it looks more like a donut; what we see in **Fig. 7** is just a cut through the donut.

A 1/4-wavelength vertical antenna has the same omnidirectional horizontal radiation pattern as **Fig. 6**, but its vertical radiation pattern is more like **Fig. 8**, since it transmits slightly upward rather than straight to the sides.

Directional antennas

Although a single vertical antenna has an omnidirectional horizontal radiation pattern, it is possible to change that by using two or more vertical antennas. You may have noticed that many AM broadcast stations use more than one tower. This allows them to tailor their radiation pattern to their coverage area. If the station is on one end of a city, it may want to direct more of its power toward that city, and less to other, less-populated areas. In addition, some radio stations must reduce their transmitted power in some directions so as not to interfere with stations farther away.

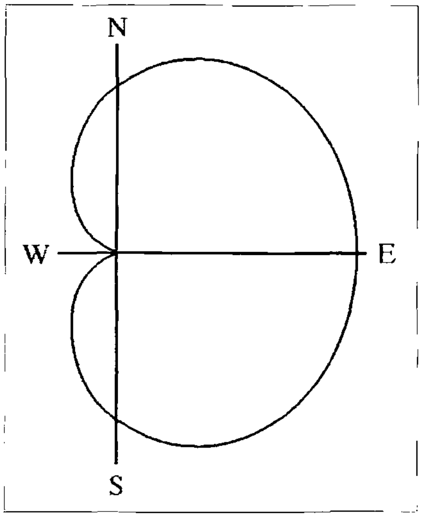


Fig. 10. Cardioid pattern from the antennas in Fig. 9.

Fig. 9 shows an example. Suppose a station has two towers, A and B, separated by 1/4 wavelength from each other, fed by two different lengths of coax cable, so that the cable to tower A is 1/4 wavelength shorter than the one to tower B.

Now imagine that you are at the far right of the drawing, east of the antennas. The signal from tower B gets to you 1/4 cycle sooner than the one from tower A (since it is closer to you), but since it had a longer cable, it was transmitted 1/4 cycle later. So the transmitted signals from the two antennas arrive at your location at the same time—in phase, and they add.

On the other hand, suppose you are at the far *left* of the drawing, west of the antennas. The signal from tower B gets to you 1/4 cycle later (since it is farther away.) It was also transmitted another 1/4 cycle later (because of the longer cable), so it arrives at your location 1/2 cycle later than the signal from tower A. The two signals are therefore out of phase, and they cancel. So the station transmits well to the east, but not to the west. The resulting radiation pattern in **Fig. 10** is called a *cardioid* because it resembles a heart shape.

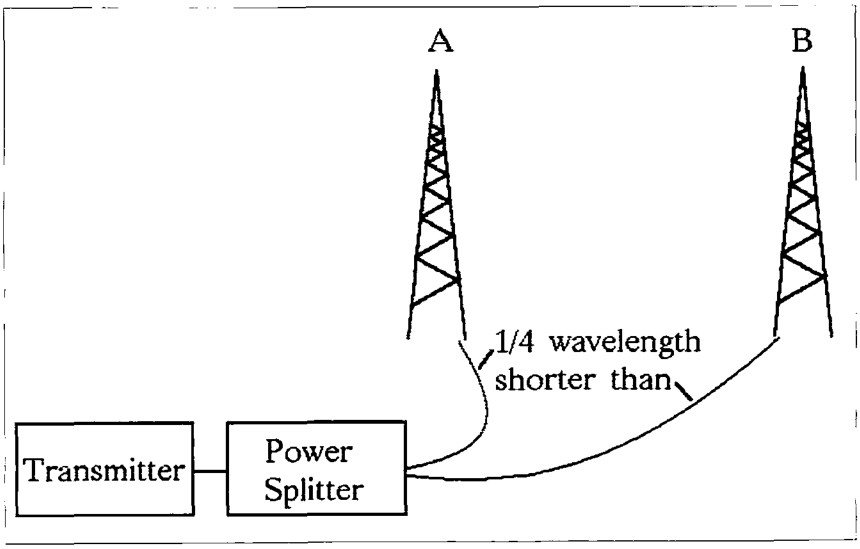


Fig. 9. Typical AM broadcast station towers.

DETOUR

The accompanying program, written in plain IBM BASIC, lets you plot the radiation patterns of various combinations of vertical antennas.

To run it, you must first specify how many vertical towers or whips there are. Then for each one you must specify where it is in relation to the transmitter (compass direction in degrees, and distance from the transmitter in wavelengths), the length of the feed cable from the transmitter (in wavelengths), and the attenuation in the cable (including any attenuation added on purpose—for example, one of the towers may purposely be getting reduced power to change the pattern).

Fig. 11 shows the radiation pattern for a two-tower setup, where one tower is 1/4 wavelength north (0 degrees) from the transmitter, and the other is 1/4 wavelength south (180 degrees). Both are fed with a cable 1/4 wavelength long, and both get equal power (assuming 0 dB loss). You see that we get a figure-8 pattern. Listeners to the east and west get the same signal from both towers, so the two signals add. Listeners north and south, however, get the two signals 1/2 cycle apart (because one tower is 1/2 wavelength closer than the other) and so the two signals cancel. You can experiment with different combinations in the program.

END OF DETOUR

The above examples were all based on AM broadcast station towers; in that case, the towers are actually fed from the transmitter through some sort of a matching network. It is possible, however, to build a directional antenna without actually supplying power to the other components. **Fig. 12** shows how; it's a

```
10 ' PROGRAM TO GRAPH    ANTENNA RADIATION PATTERNS
20 INPUT "number of towers = "; NR
30 FOR I=1 TO NR
40 PRINT "For tower"; I; "enter:"
50 INPUT " Angle (0 degrees = north)"; ANGLE
60 INPUT " Dist. (in wavelengths)"; DIST
70 INPUT " Cable length (wavelengths)"; TL(I)
80 INPUT " DB attenuation"; DB
90 GAIN(I)=10^(DB/20)
100 Y(I)=DIST * COS(ANGLE/57.2957795)
110 X(I)=DIST * SIN(ANGLE/57.2957795)
120 NEXT I
130 ' SET UP SCREEN
140 KEY OFF
150 SCREEN 2
160 CLS
170 'calculate and plot
180 LINE (0,100)-(639,100)
190 LINE (320,0)-(320,199)
200 FOR D=0 TO 360
210 XSUM=0 : YSUM=0
220 X=1000 * COS(D/57.2957795)
230 Y=1000 * SIN(D/57.2957795)
240 FOR R=1 TO NR
250 DIST=SQR((X-X(R))^2 + (Y-Y(R))^2)
260 PHASE=DIST + TL(R)
270 MAG=GAIN(R)*3000/SQR(DIST)/NR
280 XSUM=XSUM+MAG * COS(PHASE*2*3.14159)
290 YSUM=YSUM+MAG * SIN(PHASE*2*3.14159)
300 NEXT R
310 TOTAL=SQR(XSUM^2+YSUM^2)
320 X=320+2.4*(TOTAL*COS(D/57.2957795))
330 Y=100-TOTAL*SIN(D/57.2957795)
340 IF D=0 THEN LINE -(X,Y),,,0
350 IF D0 THEN LINE -(X,Y)
360 NEXT D
370 IF INKEY$="" THEN 370 ELSE SCREEN 0:STOP
```

beam antenna, also often called a yagi antenna. In the center we have a boom, which holds a number of elements. One of these, connected to the transmitter by the feedline, is called the *driven element* because it is actually driven by the transmitter signal. It essentially acts as a dipole.

Mounted parallel to the driven element are one or more *parasitic elements*, which are not directly connected to the transmitter. There is usually one *reflector*, and one or more *directors*. Each one of these parasitic elements acts as a separate little antenna.

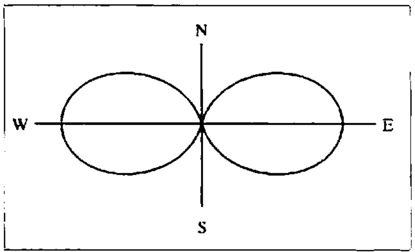


Fig. 11. A figure-8 pattern from two towers.

A normal dipole consists of two 1/4-wavelength pieces, connected to a transmission line. Suppose, however, that the transmission line was missing, and instead the two sections of the dipole were shorted together in the middle. Any signal received by the dipole would go to the middle, hit the short, be totally reflected back into the dipole, and then be retransmitted into the air. This is precisely what the reflector and directors do—since they are so close to the driven element, they pick up a small amount of signal, don't know what to do with it, and so they send it right back out again. The signals transmitted by the driven element, and retransmitted by the parasitic elements, then add or subtract to make the overall antenna directional.

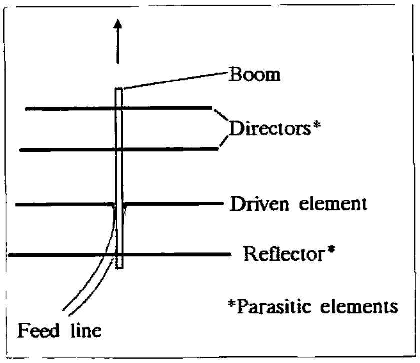


Fig. 12. A 4-element yagi beam.

Looking at **Fig. 12**, you'll note that the reflector is slightly longer than the driven element, while the directors are slightly shorter. The different lengths change the phase angles of the preflected signals to make sure that the signal is sent in the correct direction. The reflector reflects the signal, whereas the directors act as a lens to direct the signal forward. The arrow in **Fig. 12** is at the front of the antenna—it shows the direction where most of the signal goes (the other end is obviously called the back).

Fig. 13 shows the radiation pattern of a typical yagi; we assume that the antenna is aimed north in this case. We see four lobes: one *major lobe* which shows that most of the power goes north, and three *minor lobes* which show other directions where some of the other power goes. Between these lobes are directions which get no power; these are called *nulls*.

The length of a lobe represents the gain of the antenna in that direction. We will define the gain of an antenna next time; for now, let's just note that the gain of this antenna in the forward or front direction (toward the directors) is higher than the gain in the back direction (toward the reflector). The ratio of these two gains is called the *front-to-back ratio* and it is usually expressed in decibels.

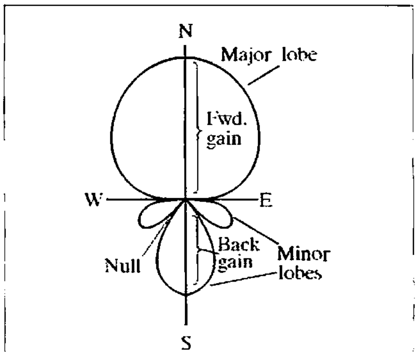


Fig. 13. Radiation pattern of a yagi.

NEVER SAY DIE

Continued from page 55

were able to join the military in World War II. When I went all around Brooklyn on my roller skates, visiting the hams listed in the Callbook, I found that virtually all were active, and almost all were in their teens or 20s.

Today, being generous, maybe one in four American licensees is active, while in Japan almost all of their hams are active. For me this explains why, though we have almost three times as many licensees as we did 30 years ago, the ham bands don't sound any more crowded.

What would our bands be like if we had five million hams? Five million *active* hams? It sure would put the pressure on our developing more efficient communications systems. We'd also be far more active in our microwave bands. The JARL magazine devotes a half page to 10 GHz activity! Here, other than as a way to pick up a few extra multipliers in a VHF contest, what activity are we seeing on the band? Yawn.

With 5 million American hams—young hams—the danger of losing our bands would evaporate, and we might even generate enough high-tech career youngsters to regain our lost electronics industries.

If you're interested in helping do something about this situation let me know.

Intruders

You're probably not going to believe this, but I have it on good authority that several hams are selling ham gear for pirate use, and in most cases the buyers aren't even being made aware that they are doing anything wrong. This has to do with 420 MHz ATV transmitters used being used for surveillance. Some ads even claim that the equipment has a range of 50 miles, with the really small print explaining that this requires the use of yagis, though it doesn't explain that the yagis required are huge antennas, and not well suited to hidden TV surveillance work.

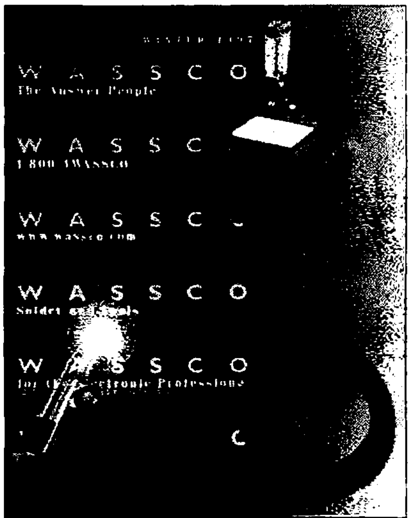
Further, both the ARRL and the FCC have been made well aware of all this problem, but neither seems to care.

Since there's so little actual ham activity on our UHF bands they are wide open for illegal commercial uses.

Is this all a matter of crooked hams doing this? No: As I understand it, Ham Radio Outlet™ got taken to court for refusing to sell a ham rig to a non-ham. And lost.

NEW PRODUCTS . . .

Continued from page 50



WASSCO Announces New Free Catalog

The new 148-page WASSCO catalog is chockful of great doodads, gizmos and stuff for the electronics professional. There are tools and equipment for soldering, testing, static control—you name it! New products from Chemtronics™ are featured, as well as Plato™ shears and Weller™ fume extractors. These fume extractors reduce harmful soldering emissions by 99.99%—before they can be released into the environment.

For your free catalog, write WASSCO at 12778 Brookprinter Place, Poway CA 92064. Phone (800) 492-7726 or (619) 679-8787; FAX (619) 679-8909, or visit the Web site at http://wassco.com.

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

Great ARRL Books!

AR1086-4 **ARRL Operating Manual** Information on how to make the best use of your station, including interfacing with home computers, OSCAR, UHF-VHF. $22.00

AR4173 **Now You're Talking! All You Need To Get Your First Ham Radio License**–A complete study guide for the Technician and Novice written exam. Practical information every beginner needs is written clearly and simply and in small doses. $19.00

AR4734 **ARRL Antenna Book**. Best and most highly regarded info on antenna fundamentals, transmission lines, design, and construction of wire antennas. $30.00

AR0402 **Solid State Design** Good basic information, circuit designs and applications; descriptions of receivers, transmitters, power supplies, and test equipment $15.00

AR3177 **ARRL Spread Spectrum Source Book** From a deceptively simple beginning, a group of experimenters set out to develop first theoretical and later practical systems for spread spectrum communications. This book consists of articles, papers and government reports that document the process whereby amateur spread spectrum progressed from the drawing board to the airwaves. $20.00

AR4661 **ARRL's Antennas & Techniques for Low-Band DXing** can be your ticket to low-band success. $20.00

New Product reviews and reviewers are welcome. Write Joyce Sawtelle at 73.

Optimizing the Hamfest Experience

The next hamfest flea market you surf can be even more rewarding.

Ronald Lumachi WB2CQM
73 Bay 26th Street
Brooklyn NY 11214-3905
E-mail: wb2cqm@juno.com

No one can deny that certain individuals experience pleasure when they visit a flea market, shell out some bucks for an item, and subsequently display their bargains with great pride. Sometimes it's just junk, but who will argue the truism that beauty is always in the eye of the beholder? The same phenomenon holds true for the hamfest participant who plans to visit an event that some (even my wife) have characterized as organized chaos. Perhaps, but there are redeeming qualities. In order not to be overwhelmed by the size and complexity of the activity, it's a good idea to know what to expect and to develop a plan that will ensure that if one attends a hamfest, one's efforts will be rewarded.

For the first-time "hamfester," the primary order of business is to check the newly arrived issues of *73* and other radio-amateur–related publications for the listings of area hamfests. The dates are published well in advance of the event. You will probably have developed a long list of wants, since few retail sales outlets exist to offer the specialty components required to complete that unique project.

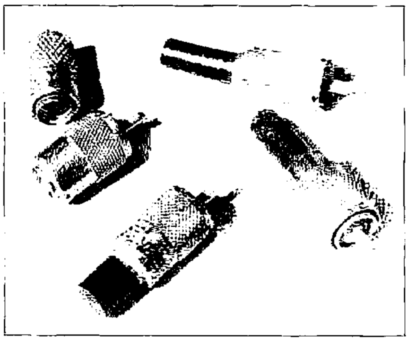


Photo A. PL259s with short cut-off lengths of 8u cable attached. 25¢ each.

If the event is not local, you may consider car pooling or traveling with friends or radio club members to save money. It takes some planning to coordinate this activity, especially if a group is involved. I've found that the trip's logistics are the least complicated aspect of this adventure. Once you've struggled through the nightmare of getting four or five hams to agree on a single travel strategy, the remaining details are difficult but not impossible to resolve. At worst, it may result in a migraine or a bit of indigestion, but the obstacles are surmountable.

"As a veteran of many hamfests in the northeastern areas, I have developed a strategy for getting the most out of this activity."

As you arrive at the parking area, it will become abundantly clear that you're in the right place. You'll be greeted by a veritable sea of mobile antennas and a host of callsign license plates. Just about now you'll begin to wonder where all these people came from—they're seldom seen during the year. It has been my experience that only on rare occasions will you encounter a ham when driving. In any event, try to park close to the entrance so shuttling back and forth with purchases is not a marathon run.

Where to begin?

Techniques for maximizing the positive experiences of participating in a hamfest visit begin when you arrive at the gate. It's amazing, but no matter what time you get to the entrance, there's always a bunch of hams queued up and chafing at the bit to get inside. You'll see an array of people, including spouses, XYLs and children, bustling about anxious to double-time the area, on the alert for that elusive bargain. They're easy to recognize. The vast majority of them are sporting baseball caps emblazoned with names and callsigns. Handhelds are either strapped to their belts or stuffed in breast pockets. The conversation is lively but the hamfesters are focused on two things: They've got one eye on their WWV coordinated watches, while the other scans for any initial movement through the entrance gate. Getting past that obstacle with the minimum of delay is top priority at this point.

Here's the dope!

As a veteran of many hamfests in the New York City, Connecticut, New Jersey, Maryland, and Pennsylvania areas, I have developed a strategy for getting the

most out of this activity. It's been refined and tuned and works well for me; I am certain that it's worth a try on your part. Primarily, I'm addressing those who are looking for particular pieces of equipment, or who perhaps need to acquire a discrete component to repair or complete a piece of gear. If, on the other hand, you're just out for an interesting and pleasurable day (with no particular motives for the visit), just go, browse, and enjoy. You'll be in the company of thousands of hams, each with a unique agenda for the day.

Oddly enough, you'll begin what will be a most enjoyable and rewarding amateur radio experience by paying your entrance fee at the gate. If you begrudge them that token amount, keep in mind that it's a pittance for so many hours of fun. If you had to pay even minimum wage to the tireless army of volunteers and coordinators of the event, the price could easily be tenfold. You'll save time

"Socializing ends as you pass the main gate."

if you have the correct dollar amount handy. The fee is usually listed in magazines and newsletters, along with other important information related to the event.

It's always a good idea to get there as early as possible. You'll find that almost everyone in attendance has the same game plan; it must be intuitive with hams. They know very well that high interest items go quickly so you've got to be Johnny-on-the-spot.

Once you're through the gate, dispense with the preliminaries as quickly as possible by filling out your door prize ticket stub and depositing it in the appropriate container. Bring a pen (and pad) with you in order to avoid the crowd jockeying for the writing implements tied to the ends of strings at the sign-in table. You'll find 50 hams waiting to use a couple of pencils. Don't forget to complete this chore, and determine whether you must be present for the grand prize drawing. During the course of the day, stubs are pulled and winners of prizes are announced via loudspeaker. During your visit, remember to keep an ear open for the announcements of the lucky ones. Somebody's got to win the door prize and it might be you!

Focus clearly on your objectives

Socializing ends as you pass the main gate. Save that for later when you'll need to make a pit stop or break for lunch! I would strongly suggest that you travel alone from here on in. If you need any counseling from your Elmer regarding a purchase, keep a handheld strapped to your belt and prearrange the monitoring of an odd simplex frequency to call for a rendezvous. If you're in pairs or small groups, time will be wasted as you wait for the gang to reassemble and move on after visiting each vendor. It's vital that you first transit the entire area quickly, especially if you're looking for items that are not generally offered by a slew of vendors. It's those dead-special, one-of-a-kind deals that you want to scoop up as quickly as possible. Do not hesitate to negotiate; there's no law that says you must pay the sticker price. Make reasonable counteroffers but avoid denigrating or otherwise badmouthing the item. Be aware that the seller usually has a good idea of the ballpark value of the component so compromise is an essential element in the process. If you're successful in locating that dead-special piece of gear and you're close in the price negotiations, I suggest you buy it. You'll kick yourself doubly hard if you return and it's gone. That has happened to me on too many occasions. I've reasoned afterwards that spending the extra dollar or two would have been worthwhile to eliminate the grief of continuing the search for an item that I may never again find.

Strategies are somewhat different for the more readily available items offered by larger numbers of vendors. As you continue your reconnaissance, use your

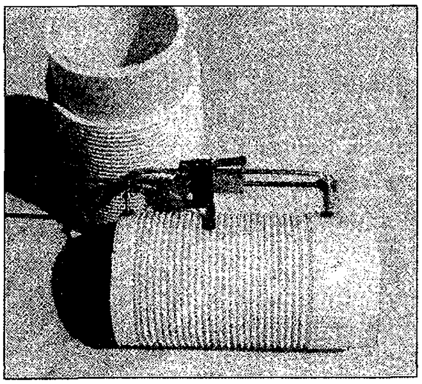


Photo B. The author's plan for a remotely tunable coil wound on a length of 3–4-inch PVC.

notebook to jot down prices and vendor locations. For example, don't buy microphone connectors from the first person you approach. These items are extensively offered and the prices may vary by 30–40%. Obviously, you want the best deal you can get. Continue your first sweep of the hamfest without any undue delay. Make whatever notations you need in order to quickly return to the vendor who's offering the best deal.

Keep in mind that some hamfests are enormous in scope. Generally aisles and rows are not identified or marked. It's easy to become disoriented and often difficult to return to a vendor quickly if at all. Latitude/longitude of GPS bearings don't work well here. Preferably, use cruder but more realistic location reminders, e.g., mid-aisle two rows from hot dog stand, or main building—rear wall. I'm certain you get the idea.

Avoid chatting during this first run. Check your want list to make certain you haven't forgotten anything of importance. If you've offered to pick up an item for a friend, make that your secondary effort. It's OK to be somewhat selfish at this point. If your pal wanted the item badly enough, he would have come himself.

During that first pass, keep a watchful eye on the equipment and components offered by the "tailgaters." These are the individuals who are cleaning out basements and shacks and lightening up on their junk box inventory. Bargains are available simply because many spouses have decreed that the beleaguered amateur may not return home until all that junk is dumped.

Here are the ingredients that make for mutually rewarding transactions. However, be a gentleman—make reasonable offers and avoid nasty confrontations. If your offer is refused, ask if and when you return whether a counteroffer would be entertained. By using this tactic, you've left the transaction open-ended rather than putting closure on what could be by this time a dead deal. Again, if you're close on the price, don't take a chance on losing out on the purchase opportunity.

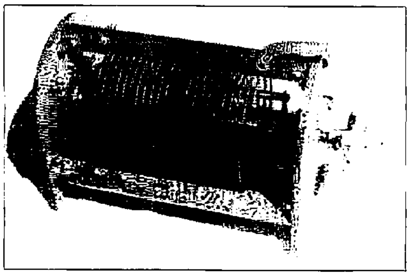


Photo C. A bargain variable inductor.

The second and third round

Once you've completed the first round, it's time to check your notes and revisit only those vendors you identified as having the best prices. Pick up your coax connectors, meters, circuit board components, power supply diodes, jumper cables, etc., and don't hesitate to ask for a special volume price. For example, you may work a deal for a dozen PL-259s for $7 rather than buying them singly or in pairs for 75¢ to 80¢ each. Certain items will always be used in the shack. Even though the up-front price may be a little more, you'll have the component when it's needed. The same holds true for volume purchases of bypass capacitors or mini 12 VDC DPDT relays, but not necessarily for a bushelful of 8-pin mike connectors or a gross of tube sockets. A bargain is a bargain only if it has utility.

Take a break at this point and bring the collected goodies out to the car. Remember: You'll need your ticket stub or hand stamp for re-entry. There's no need to lug around a bunch of plastic bags filled to the brim. Enjoy a snack and drink from the cooler you remembered to stock earlier that morning. Briefly relax and don't hesitate to reflect on the good deals you made. The day's important business being completed, it's now time for the fun part of the outing. Hopefully you have the energy, especially if it's been a hot summer afternoon. During the third, but leisurely, walk around visit the vendors with the interesting items that require more careful scrutiny. It's also the opportune time to return to those vendors who encouraged a return visit for further negotiations. You'll remember you didn't burn any bridges when there was no agreement on price for a particular item that piqued your interest. By this time, the crowds will have thinned and the frenzied feeding abated. Take some time to look through boxes for any special items of interest. Use your imagination to envision how a piece of esoteric equipment could be purchased for peanuts and utilized for a worthwhile project. I recall I once purchased the hand portion of a fighter pilot's steering control. It was a molded hand grip with a series of switches to control airplane functions (guns, etc.). If you've seen any of the World War II movies, there's always a close-up shot of this grip just as the pilot, with the enemy in sight, squeezes the trigger and the guns begin blazing away. In my application, the unit was mounted on an old wooden trophy base with a D-104 lollipop mike attached at the top. It was wired using the trigger to activate the push-to-talk circuit. I didn't shoot down any planes but I did make a few interesting DX contacts.

If on your third round trip you notice that an item you wanted is still available, spend some time with that vendor. Be honest and express your interest but suggest that the price may be unrealistic. Most probably, the seller has come to the same realization as evidenced by the fact that it didn't sell. Ask politely if he has some "room to move" on the offering price and subtly suggest that it will have to be lugged home and only brought back for the next hamfest. At this point, an Academy Award-quality performance may help. Whatever tactics you use, remember to be persistent in a dignified manner, and if you're at an impasse, suggest splitting the difference between the bid and asked price. If a deal can't be struck, leave your name and address (E-mail, etc.) in the event the vendor might reconsider. You might even take his card or telephone number and ask if you could call at some time in the not-too-distant future and check on the disposition of the component and whether the asking price has been moderated. It makes good sense to keep the dealing friendly since there is always that possibility that your paths will cross again and the deal will come to fruition.

Caveat emptor!

Purchasing electronic items at a hamfest is a ticklish issue that requires a more heightened awareness of the potential for a bad deal. Let's address the easy ones first. If the item you are considering needs a battery or AC power to operate and evaluate, take the time for a test. The condition of a keyer or a low voltage power supply is also easy to verify. There's always an outlet around

for a quick check. If it's sold *as is* then the price should be commensurate with the risk of possible damage. Agree on the terms of the transaction and make certain to take the dealer's card. Have him jot down the particulars of the sale including serial numbers and have him list the alternatives for refund or replacement if it's lugged home and it goes up in smoke or is simply inoperative. For example, it's almost impossible to test the 2 kW scale of an SWR bridge at a hamfest so it's important that you do your best to protect the cost of your investment. You'll want to know if it can be returned for refund or replacement and who will pay the cost of shipping. Do the same thing even though the component is in a sealed carton and includes a warranty. You'll need a bill of sale if it's returned to the manufacturer under normal procedures. If the vendor is reluctant to agree to reasonable terms (which is not often the case), simply say NO to the deal and walk. An intransigent dealer unwilling to offer reasonable assurance about a product may be signaling that an underlying problem exists. You don't need the grief so pass it by and wait for the next opportunity. For the purchase of any large-ticket item, it's a good idea to bring cash. Nothing works better in eyeball-to-eyeball encounters than the sight of the green stuff. Forget about checks. Remember the adage that money talks and everything else walks!

It's a learning process, too

Let's not forget another dimension of hamfesting, one that I find most interesting. After completing the regular order of business as outlined, you may want to stop and chat with some of those special participants who are clearly recognizable because of the equipment they are selling or the quality of the wares they are offering. For example, I recall a discussion with a gentleman offering homebrew tank circuits with integral band switching for 160–10 meters. He had cloned, with some modifications, a unit which had been available commercially a number of years ago. I had been working on a similar project and recognized the fact that we were indeed, because of our common interests, kindred spirits. Our discussions covered inductance measurements, impedance, and circuit *Q*. We were both concerned about the changing tank circuit electrical characteristics in older linear amplifiers when re-tubing with newer and more efficient finals. We were both aware of the fact that increased voltages cause strange things to happen as power is raised to accommodate the updated designs. I also mentioned that I planned an article discussing silver-plating homebrew wound coils. He'd already made the calculations and determined that the impedance change was only a fraction of a percent on the low bands and probably not worth the effort. It gave me food for thought about embarking on what might be just a fool's mission. He very much appreciated my comments on the quality of his efforts; however, when I asked how many of the units he sold, the answer was "none." So much for good old-fashioned linear amplifier building in this current day and age. Although I did not purchase any of the items he had for sale, for both of us it was one of the highlights of that afternoon.

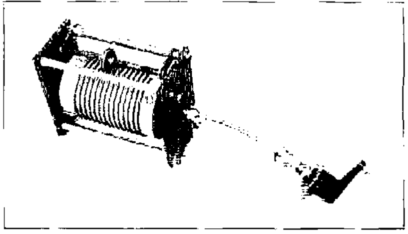


Photo D. A small variable inductor coil and flexible shaft just waiting to be stripped down and reconfigured.

Noteworthy hamfest bargains

Keep a watchful eye open for bargains. For example (**Photo A**), PL259s with short cut-off lengths of 8u cable attached were offered at 25¢ each. Clean plugs were 85¢. I opted for the less expensive units. Removing the coax occupied me as I monitored the Traders' Net and waited my turn to list. I bought all he had and received an additional bargain for the volume purchase. I've already removed the coax on two of the plugs.

I have been experimenting winding coils on PVC tubing for 160–80m applications. Coils are expensive (especially variable inductors) when purchased commercially. My plan was to design a remotely tunable coil wound on a length of 3–4-inch PVC. The plan included utilizing a 10 amp relay contact riding along a length of threaded rod to vary inductance (see **Photo B**). It was evident from the partially completed prototype that it would be great for receiving but only marginal for transmitting other than low power. During a recent hamfest visit, I spotted the variable inductor shown in **Photo C** on a vendor's table. I swooped in on my second turn around and negotiated—I paid $40 and saved 33% in the bargain. Contrast this with the purchase of a plain old 3-inch air-wound coil offered in the classifieds at $45. The inductor has no marking but is easily rated at 10 kW and can be used as a tank circuit component in an RF deck, an antenna tuner or, for my immediate needs, a most vital element in my remotely tunable base loaded inverted "L" for 160–80 meter operation.

See **Photo D**. This small variable inductor coil and flexible shaft has a wealth of parts just waiting to be stripped down and refitted in an alternative configuration. Both the support and roller shaft must be lengthened to accommodate a longer coil form. Since both shafts are tapped at the ends, that presents no problem. Larger vertical supports will be fashioned from plastic and the pilot shaft bearing from the old unit reinstalled. I'll add small pieces of metal to lengthen the coil supports and shaft to accommodate the larger diameter inductor. The flexible shaft and crank are great additions to any number of projects. This was truly a great bargain at $7.00.

Photo E shows a DP3T. This well-designed and heavily-built ceramic RF switch (75¢) was purchased for a contemplated project to control the input from an exciter to two linears. The porcelain shaft insulator pictured to the left was included in the deal. A couple of bargain hamfest SO-239s and a minibox is all that is needed to complete the project. One of the poles will be tied together with a wire bus and one position locked out. The result will be a silver-plated SPDT coaxial switching unit with a 2 kW+ rating, and a savings of a bunch of dollars over a commercially-built component of lesser quality.

Keep on the lookout for switches with a greater number of contacts (**Photo F**). They can be used on the output end of your transceiver or

Photo E. Another hamfest bargain destined for a project!

linear amplifier for antenna selection, or wired into the tank circuit for band switching.

Give it a try

For both the beginner and the experienced hamfester, these strategies are offered as a starting point from which to develop a personal perspective. Just keep a clear focus on the purpose of your visit. Try not to be involved in circumstances that will tend to distract you. Wear comfortable shoes and a hat if it's a summer event. Even though XYLs (non-hams) and children are generally not charged an entrance fee, don't take them along if you're not certain it will be enjoyable for them. Many men know the equivalent misery they experience as they tag along with their spouses from store to store as the gals surf the mall. If they do not have your level of interest, leave them home. Basically, you must move through the labyrinth of vendor stalls and automobile trunks as quickly as possible. To accomplish this you must do what you have to do in order to remain unencumbered. Doors open early and the activities begin to slacken at about 12 p.m. It's obvious that there's a lot to do in a limited amount of time. Give it a try, and good hunting!

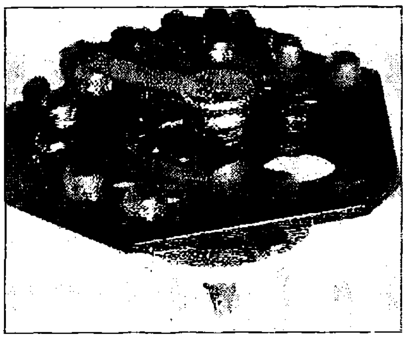


Photo F. Another find—a versatile switch.

LETTERS

Continued from page 63

another evening to install the transceiver in an enclosure. The kit does not include the potentiometers for the main tuning, RIT and the volume control. I would recommend the builder use multi-turn potentiometers for the main tuning and the RIT. Multi-turn pots make the tuning easier and more precise.

I was impressed by the on-the-air performance. The output power with a 12 volt battery is about 2 watts. The receiver is real sensitive and can pick up anything my $700 commercial receiver hears. With my quarter wave vertical antenna, my first three contacts were with stations which were greater than 800 miles from my location. Even though my reception reports were mediocre, we were able to carry on a decent rag chew amongst the fading.

I was also impressed by the quick service provided by Dave Benson NN1G of Small Wonder Labs. The kit was missing one transistor when I received it. After a phone call to Dave, I received the transistor in the mail in two days. I would recommend this kit to anyone interested in QRP operation. I understand that Dave is now offering a 20 meter and 75 meter SSB QRP transceiver for about $100. I don't know how he can afford to sell these kits at such low prices, but I am happy he does.

Listening

Most of us started out as shortwave listeners. I know I did. My grandfather had an all-wave radio and it didn't take long for me to find the 20m ham band and want to know more. Wow, South America, Europe!

Well, you know, most of us have receivers that will tune more than the ham bands, so maybe you'll want to invest in a new book, Radio Monitoring, by Skip Arey WB2GHA. This is a great how-to guide, even for the rank beginner. It explains what's out there to hear and where to find it. 337 pages, $20. Yes, it goes from 10 Hz right on up to the GHz bands. There's a lot of interesting stuff out there when you know what, when, and where to look for it. It covers the various receivers, antennas, and so on. The book is published by Index Publishing of San Diego and should be available in most ham stores... Wayne.

Number 76 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

More neat stuff for radio science observing

This month we revisit a couple of topics that are interrelated, but may not appear so initially. By combining the FMG-3 magnetic sensor and the VLF receiver, you will have an interesting method for studying the effects of solar events on radio propagation.

More on magnetic sensors

Not long ago this column discussed the magnetic sensor called the FGM-3 by Speake & Co. Ltd. in Wales, United Kingdom. The FGM-3 and other magnetic sensors are available in the United States from Fat Quarters Software [24774 Shoshonee Drive, Murrieta, CA 92562; 909-698-7950 (voice) and 909-698-7913 (FAX)]. These sensors can be used in a magnetometer circuit to measure the Earth's magnetic field. If you would like to do a bit of scientific investigation, then let me suggest that you build both the magnetometer circuit (contact Fat Quarters) and the VLF receiver we have discussed in this column in the past. Monitoring 10-30 kHz VLF shows a strong increase in distant signal levels when a solar flare occurs. Solar flares lead to Sudden Ionospheric Disturbances (SIDs), which basically wipe out high frequency shortwave propagation.

I'd like to see the correlations between the magnetic event and the onset of the flare as indicated by the magnetometer. Fat Quarters now sells a printed circuit board and parts kit that will allow you to rapidly put a magnetometer into service. The output of the Fat Quarters magnetometer is an analog voltage that is proportional to the applied magnetic field.

More on the VLF receiver

In case you missed the VLF receiver design, I am reproducing the schematic in this month's column. **Fig. 1** shows the circuit diagram for an operational amplifier version of the VLF receiver. This receiver was first designed by Art Stokes for use by members of the American Association of Variable Star Observers—Solar Division. I first saw these designs in Peter Taylor's column in *Communications Quarterly*, and in an article by Stokes. I added the RF output stage, as well as buffering, to the precise rectifier. The RF output stage was added because I found it easier to tune the receiver using an oscilloscope to view the RF signal 2E. A meter connected to the DC output can also be used, but the high value integrating capacitor (C7) makes the tuning peak broad.

The circuit in **Fig. 1** uses a virtual inductor front end. A "virtual" inductor is a circuit that acts like an inductor, but isn't. Operational amplifiers A1A and A1B form a gyrator circuit. The inductance of this circuit is the product of the components shown between A1A and A1B [C3 x 3300 x (R2 + R3)].

Capacitor C2 resonates with the virtual inductance produced by the gyrator circuit to tune the desired frequency. For the values of C2, C3, R2 and R3 shown, the circuit will tune from about 15 kHz to more than 30 kHz. Resistor R3 is the tuning control. It is a potentiometer, and should be either a multi-turn model or connected to the tuning knob via a vernier reduction drive. I elected to use a ten-turn trimmer potentiometer because it is rare to retune the unit after homing in on the station that you want to monitor.

The receiver front-end amplifier consists of amplifier A1C, which has a maximum gain of x101 [i.e., (R7/R6) + 1]. The output of A1C is an RF signal with a frequency equal to that tuned by the gyrator and C2. This signal is coupled to the RF output stage (A2A) through capacitor C5. The RF output stage shown here is a noninverting operational amplifier circuit with a gain of x2. I found that this gain was a little too much for power stations, so eventually I eliminated R14 and R15, and connected the output of A2A (pin 7) to the inverting input (pin 6). This changes the circuit from a gain-of-2 noninverting follower to a unity gain noninverting follower. Some people might want to keep the amplifier if they are in a weaker signal area.

The DC output circuit consists of a precise rectifier (A2B). The precise rectifier works like a regular rectifier, but does not have the low-voltage "knee" between 0 and 0.6 volts (for silicon) or 0 to 0.2 volts (germanium). The pulsating DC from the precise rectifier is filtered and smoothed to straight DC, at a value proportional to the signal strength, by an R-C integrator consisting of R12 and C7.

The buffer amplifier (A1D) is used to isolate the precise rectifier from the RF output amplifier. Before incorporating the RF amplifier I found that the action of the precise rectifier distorted the RF output waveform.

The VLF receiver can be built using ordinary operational amplifiers, provided they have the gain at the desired frequencies. The pinouts shown in **Fig. 1** assume a type 4136 for A1, and a CA-3240 for A2. Both are available from Digi-Key and in Jim-Packs at electronic supply stores. If you want to use all CA-3240, or single CA-3140 devices, simply adjust the pinouts accordingly. The CA-3240 is a twin CA-3140, much like a 1458 is like a twin 741.

Your setup

The next step is to obtain a means for recording the voltages from the FGM-3 and VLF

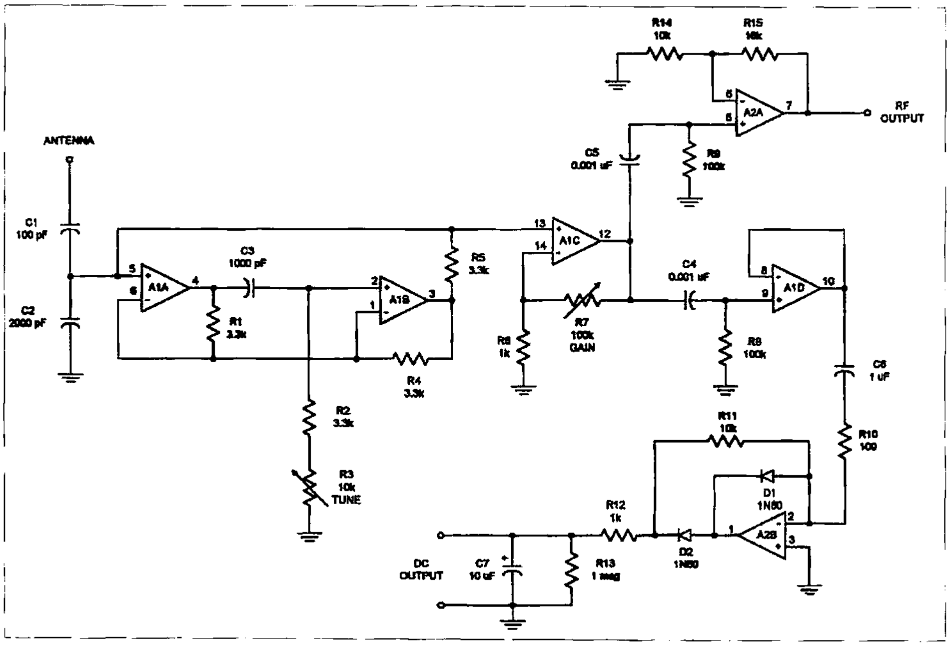


Fig. 1 The circuit diagram for an operational amplifier version of the VLF receiver.

receiver. If you are lucky enough to own (or can get) either a strip-chart recorder or X-Y recorder, especially a two-channel instrument, then your problems are solved. *If* you can get pen and ink supplies for it. Otherwise, might I suggest looking in the various magazines for an A/D converter? What you want is an A/D converter with at least two channels, that will convert the 0-5-volt DC range, at a rate of at least one conversion per second.

The A/D converter that I use works through the serial port of a personal computer. The software is DOS-compatible, so it will work with either DOS only or Windows 3.x machines. The device is made by Pico Technology Ltd. (Broadway House, 149-151 St. Neots Road, Hardwick, Cambridge, CB3 7QJ, England). They can be E-mailed at post@pico tech.co.uk, or via the World Wide Web at http://www.picotech .co.uk/. Pico Tech accepts Visa, Master Card and American Express, so you can order from the USA. I have had no problems ordering from UK firms via credit card, so don't anticipate any in the future. Also, I have never been charged import duty... all came "passed free" by the US Customs Service. I cannot guarantee that yours will come that way, but it's likely.

New books

I recently published three new books under the Newnes imprint. *Linear IC Applications* and *Linear Integrated Circuits* are published by Newnes/Butterworth-Heinemann in England, but should be available from their US office. *Microwave & Wireless Communications Technology* is published by Newnes/Butterworth-Heinemann in the US. All three books can be ordered in the US by calling 1-800-366-2665. If you want additional information, the op-amp books can be viewed at World Wide Web site: http://butter worth.heinemann.co.uk. Click on "technical books" and follow that or the new titles pathway to find my two mini home pages.

For viewing the microwave book, try site http://www.bh.com. This is the US site. In both cases, you can order through the Internet by either filling out the form and mailing it in via snail mail, or supplying your credit card information via E-mail. Because of security problems, however, I strongly recommend against ordering by sending your credit card data via the Internet. I would rather lose the sale than have you in trouble because of a credit card cyber-thief.

Connections

I can be reached via snail mail at P.O. Box 1099, Falls Church VA 22041, or via Internet E-mail at: carrjj@aol.com

Number 77 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Whether via ham radio or the Internet, one subject with which we're all becoming more familiar is video. From JPG and GIF to ATV and SSTV, picture transmission is coming into its own—so I thought it would be fun to take a break from our usual repair topics and examine video: its history, its signals and its peculiarities. Let's have at it:

The big difference

Video signals are vastly unlike audio signals. Why? It all comes down to one essential difference between sound and light: Light travels in straight lines and sound does not. Thus, light can form spatial patterns far more detailed than can sound.

This doesn't mean, of course, that dimension is not an issue with sound. We are born with two ears for a reason: Localization of sound arises from differences in amplitude and phase as the sound arrives from various locations to our ears. With only one ear, it is nearly impossible to know from what direction a sound is arriving. There are some secondary effects due to the curvature and asymmetry of the outer ear, and they can give some clues, especially regarding front and rear. But, without binaural reception, you can't get much localization. After all, can you tell whether somebody's sitting to the left or right of his radio's microphone when he's talking to you on it? Nope.

Although you certainly can hear two sounds at once, or even many of them, in reality, they're a combination of the waveforms of each sound into one composite waveform which has a definite value at any given moment. The separation of this waveform into its constituent parts is due to a miraculous feat of the human brain, which is way more powerful than any DSP chips we've yet created. So, even though you can hear an entire orchestra playing together, it's reasonable and fairly correct to think of sound as a serial, or one-at-a-time, medium, and it can easily be transmitted as such.

Because of light's traveling in straight lines, it has the capacity to form detailed spatial images. The implications of that are tremendous. Suddenly, you can't describe the whole of the information in serial fashion, because, in addition to having colors and intensities (roughly analogous to sound's pitches and loudnesses), you've also got variations of these things happening *next* to each other! In other words, you have serial events happening in parallel. That added dimension complicates matters quite a bit.

Way back when

Believe it or not, people were experimenting with television before the turn of the century. (Hmm, I guess in another couple of years, that phrase will mean something entirely different.) Even in such a technologically

primitive time, it was recognized that there was no practical way to transmit parallel events, whether over wire or, later on, via radio. There had to be some way to serialize a picture for transmission. There was, and it's essentially the same one we use today.

The concept of scanning an image and sending it serially, dot by dot, goes back to the earliest experiments with picture transmission in the late 1800s. Breaking an image up into dots had some limitations, notably in how many dots you could send per second, but it seemed the only choice. In pre–vacuum-tube days, the only way to do it was mechanically, so TV pioneers did just that!

One early experimenter by the name of Nipkow proposed a workable TV system using a rotating disk with holes in it, in 1883. By arranging the holes in a spiral pattern, he was able to scan an image, line by line, much as we do today with electron beams. It took a big disk to make a small picture, though, so his pictures were limited to under 40 lines of scanning, whereas ours can be in the hundreds or even thousands. Did it work? You bet it did! Of course, at that time, it was limited to being a laboratory curiosity, with pictures sent over wires to a nearby receiver, since radio wouldn't get off the ground until Marconi "invented" it in 1895. Imagine: People were playing with TV before radio! Even more amazing, a Scotsman by the name of Campbell-Swinton proposed the fundamentals of modern, electronic television in 1908, long before the equipment to produce it would exist. (Actually, the cathode-ray tube was invented in the late 1800s, but it took great imagination to envision using it for the display of pictures, and the concept of storing an optical image on a charged plate in the camera was wild and unique. Yet, that's exactly how it would eventually be done, nearly 25 years later.)

As early as the 1920s and 1930s, Baird in England and Jenkins in the USA had created working Nipkow-disk–based TV sets, and some radio stations were broadcasting TV programs, with the viewers connecting homemade disks with neon bulbs (which, unlike incandescents, can turn on and off fast enough to form the picture dots) to their radios' speaker leads, via step-up transformers. The bulbs would flash on and off with the received signals, and the spinning disks would form those flashes into images by scanning the same line pattern as the transmitter's disk. Synchronization of the disks was accomplished by the viewer's speeding up and slowing down the receiving disk until the image looked right. The resulting pictures were crude, but they were *pictures!* Baird sold finished sets, had his system adopted by the BBC, and even demonstrated a disk-based color TV system. Further, he invented and actually sold the first videodiscs, which stored programs on phonograph records, all in the 1920s! These brazen beginnings set the stage for the television revolution, and we've never looked back.

"Can you tell whether somebody's sitting to the right or the left of his radio's microphone when he's talking to you on it?"

Seeing pictures transmitted from far away was a tremendous thrill, but there were serious inherent limitations in the mechanical system. In addition to its huge cabinet-to-picture size ratio, mechanical TV had very limited resolution (number of dots per picture), poor gray scale (it was hard to get the brightness of neon bulbs to track that of the received signals), and there was no persistence of the dots between scans, resulting in a very dim, flickery picture. Clearly, the scanning concept was right, but the moving parts had to be done away with. Zworykin and Farnsworth were working on all-electronic television in the 1920s, and finally succeeded in making practical, all-electronic TV ready for the masses by replacing the scanning disk with a moving electron beam in a tube. It wasn't until after World War II that TV really got off the ground, though. The 1950s became the "golden age of television."

Faster is better

What made the electronic system so superior to the old mechanical one? There were several factors, including phosphor persistence that made for bright, flicker-free pictures, good gray scale, a much better cabinet-to-image size ratio, automatic synchronization, and no whirring mechanical disks. Far and away, though, the biggest improvement was in the amount of information each picture could contain. Without the need for a giant disk, the number of lines scanned went from about 40 to 525, with 30 complete frames every second! And, each line could contain many dots of information, making for a vastly more detailed image. With the small screen sizes then available, it looked nearly as good as a film shown in a movie house, and you could see it all for free in your living room. It was irresistible.

Providing so much detail on the screen each second required a lot more information to be transmitted in the first place. TV could no longer be broadcast in the 5 kHz bandwidth of an AM radio station. The new electronic system needed 6 MHz of bandwidth for each station, which is about 12 times the size of the *entire* AM band! So, TV stations had to move to VHF and UHF frequencies, with today's channel 2 starting at 54 MHz. (There was once a channel 1, but it was lost to changes in the frequency allocations.)

Lock on

Automatic synchronization was a must for electronic television. With the scanning disk, you could play around with its rotational speed and position until you got a synced picture. And, if you were lucky, it might not drift out of sync for a few minutes. With electronic circuits, that was impossible; without the mass of the disk, the drift rate was intolerable. So, while the mechanical TV's signal consisted entirely of picture information, the modern signal was devised to contain sync pulses that told the set where and when to start the scan, both for the beginning of each frame and for each line within it. They were called, appropriately, vertical and horizontal sync. Even with all this, though, there was still one problem.

I said before that electronic TV gave flicker-free pictures. That wasn't entirely true at first. The decay rate of the phosphors in the picture tube (how long it took for them to lose brightness after being struck by the electron beam) wasn't really long enough to keep the top of the picture bright by the time the beam had gotten to the bottom. Early experiments found that the resulting flicker was troublesome, so a clever, essentially free solution was found: First the set would scan all the odd-numbered lines, and then go back to the top and scan all the even-numbered lines in between them. The amount and rate of information transmission and display was the same, but the beam got to the bottom of the screen twice as fast and twice as often, tremendously reducing the amount of flicker. This breaking up of the 30 frames into 60 fields was called "interlaced scanning," and has remained an important feature of TV systems all over the world, to this day.

Well, I think we've done enough TV history for one month. Next time, we'll look more closely at the television signal, color and recording. Until then, 73 de KB1UM.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

As I write this, there are developments on the digital front I find rather troubling that shall form the nucleus of this month's column. While they may not concern everyone, their implications may well be far-reaching.

Little Orphan AEA

Back in July, 1996, I received a piece of E-mail from the folks at AEA, makers of the popular PK-232 multimode terminal unit and other digital devices, eager to link with the RTTY Loop Home Page on the World Wide Web. As many of you who have visited the page know, I maintain a variety of links to various sites related to amateur radio in general, and digital communication in particular, on the Web site. Anyway, we established such a link.

Then, in November, I heard from John P. Skubick K8JS, who wrote: "I browsed your Web pages again after a long hiatus. Nice! I read RTTY Loop each month and enjoy it.

"Actually, for your pages I prefer my usual browser, Netscape Gold 2.02©; it's better than IE 3.0© and is also very stable. IE 3.0 and previous versions of it have always been new and unwelcome 'adventures' the few times I have booted them up.

"I've been digitally inactive from ham radio for about 1-1/2 years. Before then, I was almost exclusively digital with PACTOR, AMTOR, and some packet—lots of fun, especially the long PACTOR/AMTOR ragchews with the VKs & ZLs on 20m.

"My trusty and reliable and 'stable operating' Amiga got zapped from one too many hits from the local power company's outages. Six months later I got a new 'P100' and installed OS2 Warp. (After that terrific Amiga system, I just could not put up with the archaic Win3.xx.) Warp 3.0 was not without its 'unique' logistical problems (software & drivers), so I switched over to Win95© and its subsequent enhancements & updates. Over all, W95 is very nice for me. Olde Windows? Yuk!!

"I have been active all of this time using 'basic digital' (CW) and some SSB. I have largely procrastinated [in using] the digital modes because I had drastically re-done the operating position with roll-top cabinets and hesitated to re-do 'all of those TNC cables' from the PK-232 to the HF and 2-meter rigs. Yes—a poor excuse.

"Now, I got interested in digital hamming again and was planning to get a shiny new PK-232. And, guess what? AEA, just went out of business a few days ago! Can you believe that? It's true, all right. I wonder what the heck happened to them? They had the best TNCs as far as I'm concerned. I may get that German-made PTC-II TNC; I just don't know yet. PACTOR II seems promising, but I have reservations about G-Tor's future."

Well, I enjoyed the comments about the column and Web site, of course, but was a bit taken aback by the news of AEA's demise, so I asked John where he had heard the news.

He replied: "About a week or so ago I read this about AEA on the Web-based *Ham Radio Online* magazine. A few days later, AEA's Web pages disappeared. I noticed that *QST* and a few other mags did not have any AEA ads in their respective November issues. The December *QST* just arrived, and not only are the usual AEA ads missing, but not a word anywhere in it about their demise. It's the same with the December *73 Magazine* that just arrived. No info. Nothing."

Oh, well, I guess I didn't need that new DSP-232 after all.

With this information, I checked the blurb on *Ham Radio Online*, an online magazine which can be found at: http://www.hamradio-online.com, which reported that as of November 15, 1996, AEA closed its doors and went out of business. While there are suggestions that they have been looking for a buyer, I have been unable to turn up any new information about the company from my perspective.

So there you have it. A manufacturer whose product was positioned at the top of the amateur radio market bites the dust. Of course, this is nothing new. Those of us in the hobby for many years recall legions of amateur radio names that no longer claim shelf space. From Hallicrafters to Heathkit, or Hammarlund to Gonsel, many a company has either bailed out of ham radio or folded altogether.

"There have been some rather troubling developments..."

So if AEA joins them, farewell—it's been nice. Or if a company like G & G steps forward, as it did to rescue Microlog customers, there may be some life in the 232s yet. Only time will tell, and I will keep my eyes and ears open for news. Watch here, and on the Web site, for further information.

In the meantime, we are all going to have to help out those who are new to these modes. To wit, a letter from Clarence Hermance W6RRN, of Stockton CA. He writes:

"I have been a fan of your column since I had my first model 19, so long ago. I have made some of the modems I have used over the years from your column. Now as time has passed, I have been buying the equipment instead of building from 'scratch.' My first purchase (years ago) was a CP1 for my Commodore. Worked great until I got the 'IBM clone.' Then your column showed how to put a RS-232 port on it—which I built. Haven't got it to work as yet with Hamcomm 3.1©, but I will figure it out. I think something was left out of the directions for making the jumpers on the CP1.

"Now for my latest problem. I purchased an AEA PK-232MBX with the PACTOR chips installed. It was the only one I could find in November, 1996. It was sold to me as a clearance item, as the salesperson said it was discontinued. They never told me the company had closed up. After getting it home, I found that it had apparently been a used unit or a demonstrator which would not work PACTOR. The program said it 'does not support PACTOR,' yet I was using Packratt II version 5.5a. Apparently the chips are bad, but with the company closed up, I have no way to get new chips or have the unit repaired if that is what is wrong.

"Do you have any information on where we (I and others) can get our AEA equipment worked on? This sure poses a problem to me and a few others who will need to get our equipment serviced in the future."

As I have no good information on the PK-232MBX, I turn it over to you all. My only hope is that, if nothing else, a users' group will arise to help Clarence, and others who have problems with their AEA units.

I look forward to hearing from any of you by snail mail at the above address, or via E-mail at ajr@ari.net, MarcWA3AJR on AOL, or 75036,2501 on CompuServe. Check the RTTY Loop Home Page at http://www2.ari.net/ajr/rtty/ for further developments as well.

Number 80 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

March may turn out to be a very exciting month for HF-band propagation and also for ionospheric, atmospheric and geophysical activity. It looks as if the first two weeks of the month may be rather bland and quiet, with only seasonal improvement in DX potential. The last two weeks, however, could be wild. There is a good chance of the ionosphere exhibiting active-to-minor storm levels on or around the 17th to 19th, the 26th, and again around the 29th and 30th. These periods may also bring some atmospheric storms and other geophysical events to various locations.

Seasonal increases in daylight hours in the northern hemisphere bring more UV stimulation of the ionosphere—hence greater DX potential. Also, an expected increase in solar flux due to the anticipated increase in sunspots as Cycle 23 begins its five-year rise, should help DX chasers. It is sometimes noted that the occurrence of ionospheric storms, accompanied by high signal absorption, is followed soon after by exceptional DX propagation opportunities...so don't be discouraged by poor conditions.

As you scan the band-time-country chart, be aware that when 15 meters is indicated, check 12 meters, too; when 20 meters is indicated, check 17 meters. If 40 meters is shown, be sure to try 30 meters, too. Propagation is where you find it, and forecasting is often as much an art as a science. Surprises can and do occur, so it pays to be alert and do some searching above and below the noted frequencies, and also before and after the noted times.

MARCH 1997

SUN	MON	TUE	WED	THU	FRI	SAT
						1 G
2 G	3 G	4 G	5 G	6 G	7 G-F	8 F
9 F-G	10 G	11 G	12 G	13 G	14 G	15 G-F
16 F-P	17 P	18 VP	19 P	20 P-F	21 F-G	22 G
23 G	24 G-F	25 F-P	26 P	27 P-F	28 F-P	29 P
30 P	31 P-F					

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII	20		20		40	40	80	20			15	15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

10 meters

DX possibilities are poor, but occasional openings across the equator may be possible to tropical areas.

12–15 meters

Circuits to Africa and South America can occur on Good days as shown on the chart, and short skip out to 1000 miles or more will be frequent on Good days.

17–20 meters

Twenty should be the best band for DX, with 17 coming a close second. The band should be open until after dark, with long openings into the southern hemisphere. Short skip from a few hundred to about 2,000 miles will be frequent during daytime.

30–40 meters

These bands should remain open for DX from sunset to sunrise. Signals from the east will peak between dark and midnight, while signals from other directions will peak between midnight and dawn. Daytime short skip from 100 to 1000 miles and nighttime short skip from 1000 to 2000 miles can be expected.

80–160 meters

Increases in QRN may limit DX opportunities to "quiet" evenings, and short skip between 500 and 2000 miles will be common on 80 meters. On 160, short skip and DX during hours of darkness, peaking around midnight and again at dawn, should be a regular occurrence... limited only by QRN. There will be *no* daylight activity, due to absorption. 73

QRR . . .
Continued from page 8

RFE/RL Assists Banned Serbian Reporters

On December 4, 1996, Radio Free Europe/Radio Liberty began expanded news and current affairs programming, In cooperation with Radio B92, the last independent broadcaster in Belgrade, which Serbian authorities silenced on Tuesday, December 3.

RFE/RL's Belgrade news bureau is working with journalists from B92 to provide impartial and uncensored news, interviews, analysis and discussion of the current political situation in Serbia.

A 30-minute program is broadcast daily from 21:00 to 21:30 Belgrade time on 1593 kHz from a 150,000 watt AM transmitter at Holzkirchen, Germany. An additional 30-minute daily program is broadcast 19:00 to 19:30 Belgrade time, on 792 kHz from a 500,000 watt AM transmitter at Kavala, Greece. Both stations are operated by the U.S. Information Agency's International Broadcasting Bureau.

On the air since January, 1994, RFE/RL's multiethnic South Slavic Language Service—staffed with prominent Serbian, Bosnian and Croatian journalists—currently broadcasts two and a half hours daily to the former Yugoslavia. Director of the service is Nenad Pejic, former program director of independent Sarajevo TV.

The service has become a leading source of unbiased news and current affairs from throughout the former Yugoslavia, the neighboring region and the world at large. From two and a half hours daily, broadcasting has now expanded to three hours.

Based at RFE/RL's broadcast center in Prague, the service draws on more than 30 correspondents working through bureaus in Belgrade, Sarajevo and Zagreb, and from Washington, Brussels, London, Moscow and other major capitals.

Since 1994, radio B92 has broadcast one hour of RFE/RL's program daily. The service's programs continue to be broadcast on seven other independent local FM stations in Serbia and Bosnia. RFE/RL also produces a half-hour weekly television program that airs on independent stations In Bosnia.

RFE/RL is a private, non-profit public service broadcaster funded by the U.S. Congress. Relocated from Munich, Germany, to Prague in 1995, its 21-language services broadcast 700 hours weekly to eastern Europe and the former Soviet Union.

From *RFE/RL News.*

Computerspeak

Keypad: An apartment with a lock.
Keyword: "Your place or mine?"
Light Pen: A minimum sentence prison.
Line Feed: "I've never met anyone as interesting as you before," etc.
Machine Independent: The goal of all computer haters.
Machine Language: "Zoom, Putt-Putt, Chug-a Chug-a," etc.
Memory: The part of a computer where data is placed prior to destruction.
Multipass: To try again after she turns you down the first time.
Menu: An Itemized list of ways to make a mistake on a computer.
Microminiaturization: "Get small" in computerist's language.
Mnemonic: Said of someone suffering from mnemonia.
Monitor: The first iron-clad CRT.
Multi-processing: To cook statistics more than once.
Multi-programming: To watch all three networks at once.
Multi-tasking: When one "tsk" won't do, e.g., "Tsk-tsk-tsk."
(Note: Under the most rigorously controlled conditions of pressure, temperature, humidity and other controllable variables, a computer will do what it damn well wants to do.)
n: After x, the second most popular number that doesn't mean anything.
Nanosecond: A witness to a duel between grandfathers.
Night Mode: computing in pajamas.
Network: What fishermen do when not fishing.
Non-Impact Printer: One whose signs go unnoticed.
Nybble: What an unsuspecting customer does to a line dangled by a computer salesman.
Overstrike: To tempt fate, e.g., air traffic controllers.
Office Information System: The word processor who knows the most gossip.
Ohm: Where the 'eart is.

Note: These definitions are not Intended to offend anyone. They are taken from *The Computer Hater's Handbook* (1983), as printed, and it is hoped they will be taken lightly and with humor, as intended.

By Vince WA8BIJ, from *The Tuned Circuit,* monthly bulletin of L'Anse Creuse ARC, Utica MI, January 1997.

Number 82 on your Feedback card

Ham to ham

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

This month's "Ham To Ham" has an interesting potpourri of ideas, so let's get right to it.

Stud power

From Mark Marholin KE6JJR: "If you're faced with having to replace a stud-mounted RF transistor in your commercially-made rig, or perhaps you're building an add-on 'brick' amplifier for your VHF or UHF low-power transceiver, here are some points to keep in mind before starting the job. I've hard-won these ideas over my own years of building RF amps in the 50 to 450 MHz range.

"Before mounting the ceramic-bodied, stud-mounted 'final' transistor(s), try to form the flat copper leads (bands) on the transistor as closely as you possibly can to fit the board foils and the opening in the circuit board which the transistor body occupies. This may require first bending the flat leads up at an angle, then down somewhat again for the right fit. It's much easier to do all of this pre-fitting ahead of time. Once the leads are preformed, trim off the excess to avoid unexpected additional inductances ... especially in UHF circuitry.

"Now, pre-tin the undersides of the flat leads so that when the transistor is finally in place, solder will flow smoothly and easily underneath the flat leads without the need to apply excessive amounts of heat (which might be bad for both the board and the transistor itself).

"A good quality thermal-conducting grease (silicone grease) should be applied to new transistors and any mica washers or insulators that might be involved, but don't overdo it—too much thermal grease can actually hamper heat transfer, or worse yet, can deform the flanges on some devices when they're finally torqued down.

"And speaking of that final torquing down of the nut on the transistor's mounting stud, try not to apply counterpressure by holding the device by its leads; they're not meant to stand that degree of strain. Even after soldering the leads in place, don't depend on them to prevent the transistor from twisting during the stud-tightening procedure. Stud-mounted devices usually have a flattened end on their threaded studs; hold the stud in place by that flat—that's why it's included. I hope that some of these tips prove to be worthwhile for your next power transistor installation."

Reducing heat buildup in tube amplifiers

From Richard Measures AG6K: "Excessive heat buildup, within any piece of ham radio gear, can greatly affect the trouble-free equipment life expectancy period of that equipment. In case you're in doubt, it's generally accepted that electrolytic capacitors can be expected to decrease in life expectancy by one-half for each 10 degree Celsius rise (18 degrees Fahrenheit) above normal room temperatures. This alone should be enough to convince most of us of the importance of keeping the tube compartments in older HF transceivers, and in amateur linear amplifiers, as free from heat buildup as possible.

"Another reason is the often self-destructive effects that too much heat can have on higher-power amplifier tubes—such as the popular 3-500Zs—used in many ham linears. These tubes will normally run with an orange glow on the anode material, with the expectation from the tube's designer that much of the internal heat will be dissipated by radiation and absorbed by the cooler surrounding metal chassis structure. Just as often, however, those surrounding metal parts are shiny reflective aluminum or steel, and send a large amount of that radiant energy right back into the tube instead of dissipating it as the designer intended.

"By painting the insides of these tube compartments a flat black, considerably more of the radiant energy will be absorbed and safely carried away than if the metallic surfaces are reflective and force the energy to bounce back and forth between the tube(s) and the enclosure. This is a simple point of physics that some product design engineers overlook: Bright or shiny surfaces always reflect, and dark dull surfaces always absorb radiant energy, and heat is radiant energy. Kenwood's TL-922 linear amplifier, as an example, *does* have flat black tube compartment walls.

"If your particular amplifier doesn't, black liquid shoe polish is one simple answer. Apply it evenly to all of the reflective compartment surfaces, especially those that would reflect radiant energy right back into the tubes themselves. This simple step will help the equipment's cooling fan to do its job, and help to keep your gear functioning longer, cooler and more trouble-free."

Moderator's note: I've applied Rich's idea to my own Heath SB-1000 and can vouch for its effectiveness. I painted the internal walls of the tube compartment with flat black paint and immediately noticed a substantial increase in the amount of heat absorbed by the compartment walls; very little of that heat will find its way back into the 3-500Z itself. What modification could be simpler? Just make sure that the power is unplugged and the power supply's capacitors are completely discharged when you're working inside any compartment that carries high voltage. I always clip a jumper from the anode of the tube to ground whenever my hands are in or near the final RF compartment. I learned the value of that years ago when working inside broadcast transmitters. "Inside" is the right word; you could actually walk inside our VHF TV transmitter!

Workbench pin-up

From John Nix: "Fig. 1 shows a handy nomogram to keep near your workbench. The dictionary definition of a nomogram is 'a graph that enables one, with the aid of a straightedge, to read off the value of a dependent value when the values of two or more

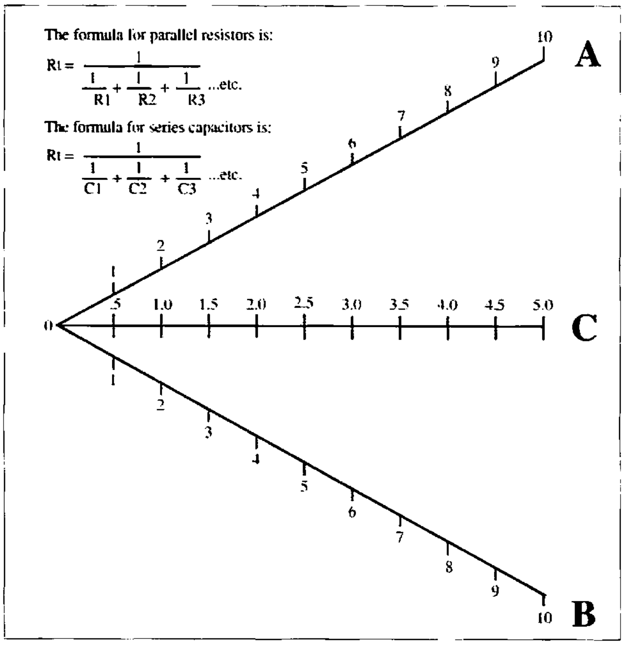


Fig. 1. John Nix's nomogram for approximating the value of parallel connected resistors or series connected capacitors. Lay a straightedge across the graph from Scale A to Scale B at the point representing the two component values, and the resulting equivalent circuit value of those two components is read from Scale C.

independent variables are given.' This one allows you to quickly approximate the equivalent value of two or more parallel resistors or two or more series capacitors. Simply lay a straightedge between the values that you want to combine on the top and bottom angled lines (Scales A and B), then read the equivalent combined value on the straight line in the middle (Scale C). It's much faster and easier than struggling with the all of the division needed for the 'standard' parallel resistor or series capacitor equivalency formulas (also shown in **Fig. 1**).

"For instance, a 270 ohm resistor in parallel with an 820 ohm resistor is 203 ohms. A .022 µF capacitor in series with a .047 µF capacitor is .015 µF. Remember that the value will always be lower than the lowest of the two individual component values for resistors in parallel and capacitors in series.

"To figure multiple resistors in parallel or capacitors in series, simply use the first two values and find the equivalent on the nomograph, then use that answer plus the third value for the next equivalent and so on until all of the values have been accounted for. The final value is the overall equivalent circuit value of all of the components in that parallel (resistor) or series (capacitor) circuit."

Moderator's note: The nomograph in ***Fig. 1*** *is only useful for values within the same power of 10, i.e., when all of the resistors in a parallel circuit are in ohms, hundreds of ohms, thousands of ohms (k), etc. To find the equivalent of a 470 ohm resistor in parallel with a 10k ohm resistor, best use the longer formula (by the way, the answer is 448.9 ohms!). Thanks for another nice chart, John.*

Big dipper

From Phil Salas AD5X: "For waterproofing outdoor connections and connectors, I've had very good luck with a product called Plasti-Dip™. It's a fast-curing liquid plastic material that's intended primarily for coating tool handles. A can of it costs about $7 at hardware and home centers, but it should last you a good long while. I usually put two coats of it on all of my outdoor connections. For wire connections, such as separating a coax shield and center conductor for feeding a dipole antenna, I immobilize the point where the shield and center conductor separate with hot glue (hot glue guns are great for a lot of things like this). Then I attach solder lugs to the ends of the shield and center conductor as the connection point to the antenna's balun. Finally, I dip the entire end of the coax (including the solder lugs) into the Plasti-Dip and let it cure. After curing, I use a hobby knife to trim off the excess Plasti-Dip insulation that covers the ends of the solder lugs. Neat, easy and if done correctly, waterproof!"

TTT (transformer test tip)

De your moderator, Dave NZ9E: Here's a tip for easily and accurately testing the insertion loss of transformers, whether they are AF transformers or RF transformers. Testing the actual dB loss in step-up or step-down transformers is tricky because of the different impedances presented by the primary and secondary windings: dB loss formulas assume like impedances on the input and output of any device where dB gain or loss is to be calculated. But with transformers, this criteria is easy to meet, simply by using two identical transformers (same type number) and hooking them up back-to-back (see **Fig. 2**). Now the input and output impedances are identical, so the loss can be measured by simply comparing the differential in voltage between the input of the two and their cascaded output, then dividing that result by two. If your measurements indicate a 6 dB loss using two identical transformers back-to-back, it's safe to assume that each is responsible for 3 dB of that loss, certainly close enough for all but the most exacting applications.

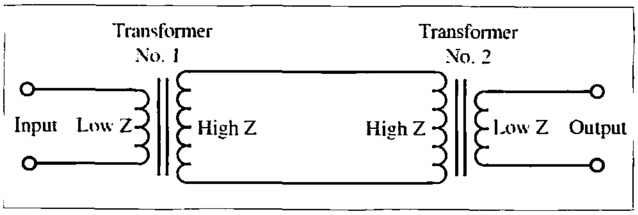


Fig. 2. *Two identical transformers connected back-to-back for easily checking their insertion loss in dB. See NZ9E's tip in the text for further details.*

"You've just uncovered your 'hidden' QRP meter and you didn't even have to lift your soldering iron to do it."

Hidden QRP wattmeter

From Ken Guge K9KPM: "Wanting to accurately measure the 2 watt RF output from my Kenwood HT, I spotted the Daiwa CN-550 cross-needle VHF SWR/Power meter sitting on my operating bench. The Daiwa CN-550 measures forward and reflected power directly in watts, with two separate meter needles, and then it 'computes' (on the meter's scale) the SWR by where those two separate needles cross. I'm sure everyone's seen this type of meter even if you don't currently own one. The forward power scale has a range of zero to 20 watts on its most sensitive range, but even at that, the 2 watt point for my HT's RF output is only about the lower one-fifth of the full 20-watt scale markings—OK, but not great for accurate QRP measurements.

"It occurred to me that the reflected scale, zero to 4 watts, would be the perfect one to use, with the zero to 2 watt portion on the scale covering about three-quarters of the meter's range; several magnitudes better than the forward scale. It's amazingly simple to use that reflected scale for measuring low power outputs—simply hook the unit up backwards!

"Instead of having the HT's output cable going to the 'TX' connector on the CN-550, connect it to the 'ANT' connector instead. Then put your dummy load (a low power one is fine) on the 'TX' connector of the meter. You won't be able to see your SWR correctly, but you no doubt already know that your dummy load is very close to 1:1, so it's no loss. What you will see, though, is your forward power—now on the 'reflected' scale—in far greater detail. Small adjustments can be made to your low power HT and the results will be easily visible on the zero to 4 watt right-hand reflected scale. You've just uncovered your 'hidden' QRP meter and you didn't even have to lift your s oldering iron to do it."

Moderator's note: I've had a Daiwa meter like the one that Ken mentions above for years, and have never really seen it in that light before! Ken's idea clearly illustrates what 'ham ingenuity' means: Looking at an item from another point of view and 'inventing' a new use for it. Of course you can apply the idea to any of Daiwa's (or other manufacturers') dual-needle meters, in any frequency range. Another nice tip, Ken.

That wraps up this month's column; does anyone have any ideas on "different" uses for common items such as K9PKM gave us? Send them, or any other ham-related tips, ideas, suggestions or shortcuts to me at the address in the masthead, and I'll share them with the rest of *73*'s readers. That's our purpose, sharing practical ideas Ham To Ham.

Richard L. Measures AG6K
6455 La Cumbre Road
Somis CA 93066

John Nix
9123 Highway 23 NE
Foley MN 56329-9501

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

Ken Guge K9KPM
1107 E. Woodrow Avenue
Lombard IL 60148

Mark Marholin KE6JJR
1588 Four Oak Circle
San Jose CA 95131

QRP

Number 84 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Well, it looks like we made it through another winter in the Midwest. Lucky for me, this year I don't have to fix the damage old man winter did to my antennas. On the other hand, I spent most of the winter with nary an antenna. What little hamming I've been able to do has been with a mobile HF antenna affixed to the car—with a run of coax into the apartment. Needless to say, I can't wait for the house to be finished. But while I wait, I can plan my dream antenna farm. During the best of times, I've never really had a "really good" antenna system. With three acres on the new home site, I can grow lots of antennas.

Even if you don't plan to redo your entire antenna farm, if you're running low power you need to get every last milliwatt in the air. Winter can be really tough on your antenna farm. So, before the grass starts to grow, let's look at what is left, and the best place to start is the feedline.

You get what you pay for

And when it comes to feedline, if you try and save a few nickels here, the results will surely bite you in the butt! Lossy cable may work if you're running 100 watts. Even if you are using really bad coax and lose half your power to the cable, you only lose one S-unit. At the levels most QRP operators use, losing half your power to lossy feedline (and that same S-unit) would be a death blow to your signal.

So, if you purchased your feedline new with the rig, and that rig has tubes in it, replace the coax! Unlike fine wine, coax does not get better with age.

So when should you replace your coax? I really can't say. Coax used up and down the tower should be checked/replaced every five years or so. If you live in a climate having lots of sun or salt mist, perhaps you should change it more often.

"Unlike fine wine, coax does not get better with age."

The outside jacket should be free of cracks and abrasions. If you find your feedline looks fine except in one or two sections, don't try to splice in new runs. Aside from the extra work, it's not really going to fix the problem. Water may have seeped into the line and ruined it. Damage from rabid ice weasels may go unnoticed as well. Run your hand along a section of coax. If your hands turn the color of the coax, UV damage has occurred; replace it.

Check the connectors at both ends (see **Fig. 1**). The jacket should be inside the barrel of the connector. Any exposed braid means there's a good chance water may have entered the coax. Of course, if you can see the connectors, why didn't you seal them off with some tape and coax sealer after you installed the coax in the first place?

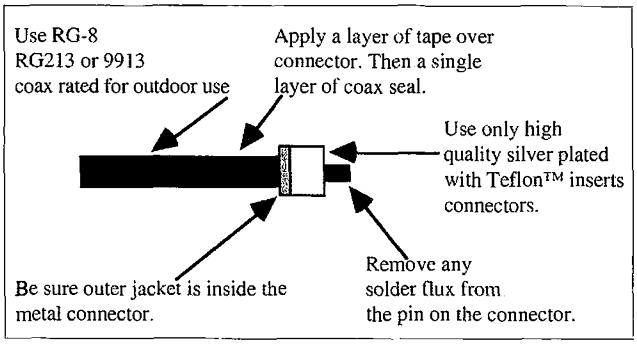


Fig. 1. Proper protection of outdoor coax connectors.

What coax to buy?

Always buy a name brand. I don't care what the guy behind the counter says; if the stuff is any good, the manufacturer will put his name on it. You really do get what you pay for. Don't go for the surplus coax either, unless you know where it came from. Fresh surplus is fine, but stuff from World War II is just wasting your money.

For runs up the tower, I always recommend and use RG-8 cable. Another really good cable to use is the RG-213. It's about the same price as the RG-8, but with slightly lower loss specifications, especially on the upper frequencies. 9913 is also a good choice for HF. Check out the *ARRL Handbook* for a listing of different coaxes and their losses at various frequencies.

Just like chocolate, there are zillions of varieties of RG-8. You'll see UV resistant, direct burial and abrasion resistant, among others. Get the kind you need, but don't pay more for something you don't need.

Connectors

While shopping for new coax, how about the connectors on the ends? Please don't waste your money and get those cheap imported guys with the plastic centers. They're just not worth the hassle. I always choose amphenol RF connectors. And I always go with the silver-plated connectors, too. The last ones I used had the Teflon™ center. I highly recommend you do the same. If you're not an expert at attaching an SO-239 connector, the Teflon will allow you some leeway when soldering. The plastic center connectors will melt! Get the connector hotter yet, and the center of the coax will melt as well!

Is the gold SO-239 any better? Well, *I'm* not going to spend the extra money to find out. The gold would prevent the connector from becoming corroded, but other than that, I'm not sure they are worth the money.

There's been a lot of paper consumed showing hams how to put on an SO-239 connector. I suggest you take a look in the *ARRL Handbook* for a step-by-step walk-through. I can tell you those small holes around the barrel of the connector are not to let the steam out.

To install a connector onto an end of coax, you'll need the following: First, use a clean connector free of dirt and corrosion. The silver plating makes soldering much easier. Next, you'll need a high wattage soldering iron. I like to use a 45-60 watt iron. A soldering gun won't cut it. You need to heat the connector up as fast as possible to avoid damage to the coax.

A good grade of solder is also important. I use a low flux solder by Kester™. It's called the "no clean 245." Digi-Key™ handles it. The Digi-Key catalog number is KE1400-ND, and it costs about ten bucks a pound. With this stuff, there's no big glob of solder flux hanging on the end of the connector after you're done. The connector is not as slimy with flux, either, when you're done.

Don't cheapen up on the inserts required with smaller diameter coax. It makes little sense to spend three bucks on a silver-plated connector and then use a 20-cent insert.

And for reasons known only to some hams, don't reuse old SO-239 connectors. They're just not that expensive, so splurge and get new ones when updating or repairing your antennas.

If your plans include connectors outside, first wrap the connector with a layer of black electrical tape. Then apply a layer of coax seal. That first layer of tape will allow you to undo the connection without trying to clean off the coax seal.

Open wire feed

I use two kinds of open line feed. For temporary installations, I use cheap 300-ohm TV line. This stuff is great for Field Day! I also use 300-ohm TV line when

testing new antennas. Of course, this assumes the antenna requires open line feed. Although I know there will be some difference in performance between the 300-ohm and 450-ohm feed, it will be fine for a test or two. At the home station, I use 450-ohm ladder line. I can tell you to get the stranded type and not the solid. The stranded line is *so* much easier to use.

If you use ladder line, check the connections at the top of the tower. It's not uncommon at all to have one side of the ladder line break off. That's why it's best to use some sort of hanger to support the line from above.

Use TV-style standoffs to keep the ladder line away from the tower legs. Don't overlook the aluminum spouting and siding. Newer homes use all-plastic downspouts and siding, but check anyway.

It's the little things

While you are out working on the antennas, check any balun(s) you may have in your system. Although you can't do much in the way of electrical checks, give them a good going over with your eyes and fingers. I've never come across a water-cooled balun, so if your balun sounds like a half-filled bottle when you shake it, trash it! Check for loose-fitting hardware and broken wires. Make sure the connector is dry and fully encased in coax seal. Retape and reseal if needed.

How many coax switches do you have? Check them for proper operation. One very old Heathkit switch I had developed a low resistive short to ground on two outputs. Opening the switch revealed a splatter contact or two. Perhaps the switch had taken a lightning strike.

If you put in new coax or open line feed, how about making up some new jumper cables? If you're like Randy KD8JN, you'll need some RG-8 cable to connect the Argonaut 515 to the SB-220. But those are usually way too large and bulky for most QRP rigs. Some of the micro rigs aren't heavy enough to hold the coax down on the table, so don't forget to make up some RG-8 mini cables, too.

Don't overlook your ground system. Many QRPers don't even have a good RF (or DC) ground in their shacks. That's wrong. If for nothing else, it's a good safety feature and is required in most cities. Check the connection between the ground rod and the cable connected to it. It's possible the cable has corroded through. Tighten up any clamps on the grounding rods. This is especially true if you live in California. Those earthquakes have a tendency to loosen up just about everything.

I prefer to use the braided copper straps for ground runs. This stuff is very flexible and easy to work with. Copper ground bus strips are ideal, too. They allow you to connect all your equipment together. Don't daisy-chain your grounds together—you'll open up the possibility of ground loops. Use a single-point ground (see **Fig. 2**). And for goodness sakes, don't ground your gear to the gas pipe. The sewer pipes are another no-no. Also, don't depend on the ground or common wire inside your electrical service.

Mike's dream system

Right now, as I type this, my new shack is nothing more than a very expensive muddy hole in the ground. As spring approaches, things should start to take shape. So, here are my plans for my QRP shack.

For openers, I plan to install a 60-75-foot free-standing tower. The 10-foot difference between 60 and 70 feet is very costly. The tower should be able to hold 20+ square feet of antennas.

For 20 through 10 meters I decided on a log periodic array. For weak signal two meter work a 17-element boomer is planned. Also on two meters will be a Ringo Ranger for repeater use.

I'm planning a solar-powered weather system on the south forty. This will be linked into the Skywarn network via packet, so a small vertical antenna will be installed just for this weather system. Right now, this idea is still very much in the planning stage.

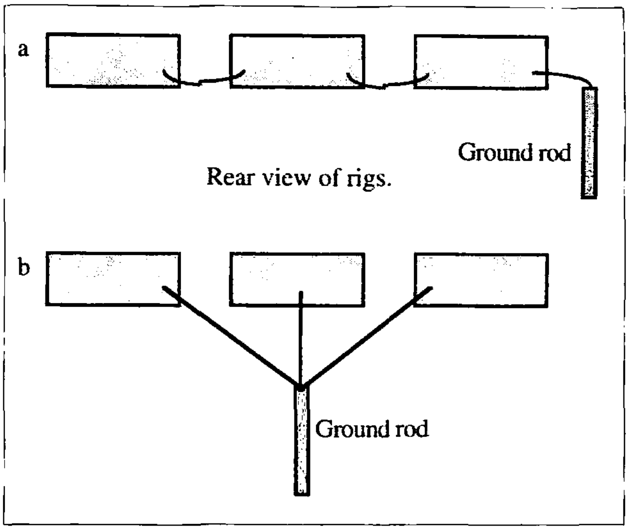


Fig. 2. a) The wrong way of grounding your station equipment; b) A better way of grounding. This is called single point grounding.

On the low bands, a full-wave 80 meter dipolc up at the 60-foot mark on the tower. For 40 and 30 meters, there will be centerfed zepp antennas fed with open line feed. Since there are no trees on the land, these dipoles will be configured as inverted "vees."

My only problem so far is finding a way to pay for all this stuff! On the other hand, it costs nothing to dream.

Next month I'll give you the information about the Four Days in May QRP forum to be held again at the Days Inn during the Dayton HamVention.

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Blast Off With Exciting Activities

Every year, one of the favorite enrichment units in our ham radio class is the one we do about the space program. Maybe you can't always be speaking with one of the astrohams, or maybe your school won't get picked to participate in the SAREX program, but you certainly can provide a stimulating and exciting series of activities involving space and communications.

Twenty-eight years ago, on July 20, 1969, an estimated one billion people around the world—a quarter of the Earth's population—watched the first manned moon landing on television. If your students can learn about the Apollo 11 mission and the moon, they'll come away with a sense of the mission's impact on their lives.

Plan your research strategies well before you introduce this unit of study. Work with your school's librarian as well as with local library personnel. Help gather videotapes, newspapers, magazines, and documentaries to be made available. Be sure to check out organizations that will have materials available for classroom use, such as The Young Astronaut Council, with its Young Astronaut Program and Young Astronaut Clubs. They can provide information, curriculum materials, activities, and lots of ideas for your Apollo 11 and other space-related school projects (**Photo A**). Contact the Young Astronaut Council at 1308 19th St. NW, Washington DC 20036; (202) 682-1984.

"Ellie Van Winkle NØQCX and her husband Rip NVØM created the BARC Jr. club for youngsters interested in ham radio."

NASA Teacher Resource Centers in 11 locations around the country offer educational videotapes, slides, audio tapes, publications, teacher guides, and more. Call the NASA Goddard Space Flight Center Teacher Resource Laboratory at (301) 286-8570 to get the location and phone number of the center nearest you.

Photo A. Seventh graders James and Matt enjoy space-related activities like building dioramas.

For a 26-minute video of the Apollo 11 mission contact NASA Center for Aerospace Information at (301) 621-0390.

One fun activity you can do with your class is to have them write the famous sayings associated with the landing. Talk about those famous quotations and what they mean. Why is each quote so memorable? Then have the students put themselves in the place of each author. What would they be seeing, hearing, and feeling? Make a chart and have the children add their own quotes (see **Table 1**).

Event	Famous Words	My Famous Words
The moon landing	"Houston, Tranquility Base. The Eagle has landed." (Neil Armstrong)	
The first step on the moon	"That's one small step for a man, one giant leap for mankind." (Neil Armstrong)	
The plaque	"Here men from the planet Earth first set foot upon the moon. July, 1969 A.D. We came in peace for all Mankind." (NASA)	
A description of the moon	"Beautiful! Beautiful! Magnificent Desolation!" (Edwin Aldrin)	
Presidential phone call to the astronauts	"Because of what you have done, the heavens have become a part of man's world. For one priceless moment in the whole history of man, all the people on this earth are truly one." (President Richard Nixon)	

Table 1. Do-it-yourself quotation chart.

A good magazine to subscribe to for your classroom is *Odyssey*, published by Cobblestone Publishing, Inc., 7 School St., Peterborough NH 03458. Copies of the issue titled "Magnificent Moon" may still be available. Call (800) 821-0115.

It's also fun to have the kids bring in models they've built. Commercial plastic model kits of the Command Module, Lunar Module, and Saturn 5 rocket (stock numbers 5083, 5081 and 5082, respectively) are available at local hobby stores from Monogram Models. Have fun!

Ham Radio Family Night

Like most hams, one of the things I like best about going to the Dayton HamVention every

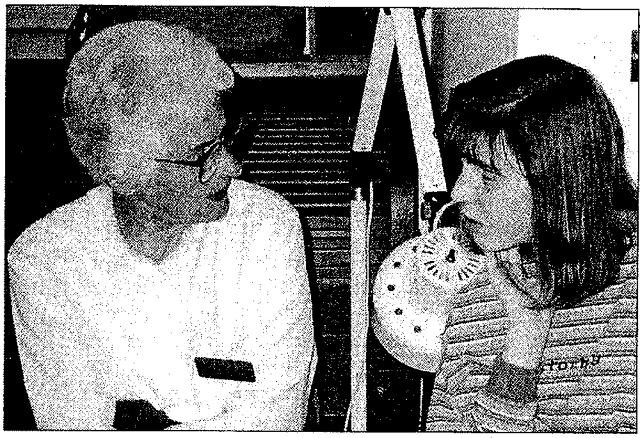


Photo B. Elmira Bebe Greenlee KDØGE elmering Tracy Shelton (now KBØBX) for her Novice license. Photo by Ellie Van Winkle NØQCX.

year is making so many new friends. I met Ellie Van Winkle NØQCX from Boulder, Colorado, nearly five years ago at Dayton. She is a retired kindergarten teacher, and she and I bonded instantly. Ellie and her husband Rip NVØM created the BARC Jr. club for youngsters interested in ham radio (**Photo B**).

Over the past few years, the Van Winkles have become good friends who share all of BARC Jr.'s activities with me. With their tremendous efforts, and the help of interested parents and other club members, they have provided me with some of the best presentations at the Dayton Youth Forum in the past four years. For Dayton HamVention '96 they outdid themselves by training and bringing the BARC Jr. Dayton Team to do a presentation. The children had a roundtable discussion about why their club was so successful and how they managed to raise money to come to Dayton. It was a wonderful and informative presentation.

Last month, Ellie sent me a videotape of the BARC Jr. Family Night. There are so many good things that come out of a night like this that I decided to share it with the readers of this column. Certainly modifications to suit individual club needs should be considered by any club with a growing number of young people in it. It's important for the children coming into amateur radio to know that they are welcome and that they are encouraged to participate.

"The children explain to their families all about Field Day, building kits, and foxhunts, and speak proudly of their accomplishments."

Why a "Family Night"?

The purpose of the club's Family Night is to share the BARC Jr. activities with other family members. It provides a chance to enlighten parents about the ham radio teaching program, the progress of their children, and to introduce them to the Elmers and Elmiras who provide the instruction. Ellie also likes to have the parents get an understanding of the value of the hobby to young people.

After three years of operation with BARC Jr., the Elmers and the children felt a need to share with the involved families what and how the kids learn, and why the kids and Elmers so enjoy getting together each Saturday at 2:00 p.m. for one and a half to two hours.

According to the Van Winkles, and what I observed on the tape, the children really enjoy Family Night. It gives them an opportunity to discuss community service activities, share stories about speaking around the world, tell about their young ham net and foxhunts, and talk about learning CW and theory. The children explain to their families all about Field Day, building kits, designing and building antennas and fund raising projects. They also speak proudly of their wonderful presentations at the Dayton Youth Forum and of how to get more youngsters into the hobby.

As seen through Ellie's eyes, the value of a Family Night comes from:

1. Educating the families about their children's activities and gaining an appreciation of the dedication of the adults who provide the instruction.

2. Cross education—parents educating one another, kids educating other kids, and parents, kids, and Elmers all educating each other in a variety of ways.

3. The socialization aspect—the getting together of everyone with the children's best interests at heart is extremely valuable.

4. Family Night helps parents, kids and Elmers evaluate possible candidates for the Dayton Youth Forum, as well as for local speaking engagements.

By sponsoring the very successful BARC Jr. group, the Boulder Amateur Radio Club has provided the rest of us with an excellent role model. Getting youngsters caught up in the excitement of wholesome and stimulating activities with adults can only have positive ripple effects which will keep going on and on for years to come. I am delighted and proud to feature the outstanding work of this group. I know we all wish them continued success. See you at Dayton!

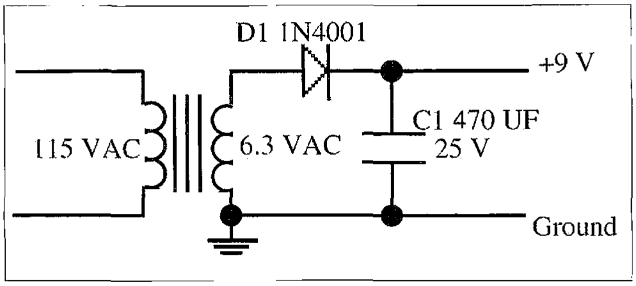
Number 88 on your Feedback card

UPDATES

Danger!

In "Build This Receiver Preamplifier," which appeared in the January issue, beginning on page 26, there are a couple of weird glitches in the schematics. One of them could be dangerous to the builder.

Most importantly, **Fig. 4** should look like this:



The transformer is not supposed to have connections from the transformer primary to the secondary. This is a dangerous error and could cause serious problems if built the way it is shown in the January issue.

Then, the other points. In **Fig. 1**, the unidentified resistor in the lower left (from **Q1** to ground) should be **R2** (5.6k). **C5** should show a connecting dot to **+9V**, and the device identified as "**02**" is actually **Q2**.

Finally, in **Fig. 3**, the words "flat side down" were omitted. We apologize for these errors.

Enhanced Schematic

Also in the January issue, in N4UAU's "Enhanced Automatic Voltage Controller" we have a few things to straighten out. On page 42, in the schematic:

Pin 3 should not be connected to ground. If it is built as shown, there will be a big puff of smoke and one very unhappy builder.

The unlabeled resistor by **T1** is **R11**.

The unlabeled resistor near **C1** is **R15**. It has a value of 0 for the Bar Mode and 360Ω for the Dot Mode.

On page 45, in the Parts List, the values for **R4** and **R5** are reversed.

J. Frank Brumbaugh KB4ZGC also brought something to our attention from the same parts list—all resistors should not be 1.4 watt; they should be **1/4** watt. This was a computer translation error, but we apologize for any confusion.

HE'D RATHER OPERATE "MOBILE-IN-MOTION" THAN HAVE TO SIGN "PORTABLE"

Including Ham Radio Fun!

73® Amateur Radio Today

APRIL 1997
ISSUE #439
USA $3.95
CANADA $4.95

International Edition

Special Antenna Issue!

Colloidal Silver Generator

Instant 4-el. 2m Beam

Simple 20m Phased Array

The Magic of Small Loops

TV Tuner Bonanza

Goodbye, Mr. Morse!

Reviews:

Hamtronics TA-5

Cable X-Perts G5

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM (ok) or Mac (preferred) formats), carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

Including Ham Radio Fun!

APRIL 1997
ISSUE #439

73® Amateur Radio Today

TABLE OF CONTENTS

FEATURES

REVIEWS

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: Northern Kentucky QTH of proud owner Jim Brown AE4EY features 45-foot, crank-up, tilt-over, all-aluminum Aluma-tower; 5-band, 2-element HF quad by Lightning Bolt Antennas: 4-element 2m quad, also by Lightning Bolt, nested inside the HF quad; 2m Cushcraft Tingo atop the mast; multi-band Radio Works Carolina Windom supported by a cross-arm from the tower in a flat-top configuration; and (whew!) Cushcraft R7 multi-band vertical mounted on top of a fence off to the right. The tower is mounted on a tilt-over base and raised and lowered via a cable through a pulley attached to the chimney and then fastened to a car bumper. (Another tower-pulley-cable tale—involving insurance—appears on page 84.)

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

The Handwriting

A couple of things almost got me to thinking. One was a well-considered letter by Ken W8VWZ wherein Ken made a very good case for those who believe that keeping the code test as an obstacle to keep new hams from joining our fraternity is sounding the death knell for amateur radio. The other was a review of the license statistics over the last ten years.

I did a hasty addition of the number of Extra/Advanced/General licenses as a percentage of the total licenses and found that the percentage of encoded hams has been dropping steadily, dropping from 61.6% in 1986 to 44.2% in 1996, and this was a straight curve drop. If I then subtracted in the number of hams who have dropped out of the hobby, either from a lack of interest or through death, which the FCC's ten-year licensing system ignores, the percentage is more like 38.8%, and that brings us to our having about 16% HFers in ten more years—unless we make some serious changes. I have seen no hint of any proposed changes coming from the ARRL. Have you?

And we'll be down to 10% in 13 years! Well, that'll certainly reduce the QRM on the HF bands!

This drop in HF hams explains why so many ham radio stores have been going out of business, and why the manufacturers of HF equipment have been having such a tough time. Our new no-code hams have an average ham station investment in the hundreds of dollars, while HFers tend to be more in the thousands.

I don't know how much of a difference getting rid of the code requirement might make, but polls of the no-coders tell us that this is the main obstacle to their upgrading. And considering the potential for us to lose our UHF and VHF bands, Ken could well be right that the Old Guard intransigence on maintaining the code barrier will be the death of amateur radio.

Sure, the Internet is already making DXing easier than fighting the QRM on 20m. And the profusion of commercially made ham gear has discouraged building, which has, in turn, made our access to parts more difficult. But we still have a world of adventure to offer the motivated.

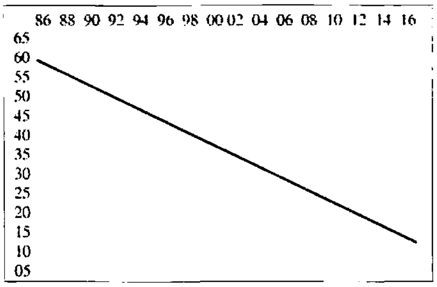


Fig. 1. Here's the percentage of General/Advanced/Extra Class (code barrier) licensees plotted from 1986 to 1996. This projects to about 8% by 2016, unless the code barrier is removed or the hobby is discontinued as no longer relevant. The ARRL destroyed the American ham industry and our recruitment of youngsters 30 years ago; now they're destroying the hobby and themselves. I wish I were exaggerating.

More Bio-E News

An Ohio reader who's been using the Bioelectrifier (*73*, May 1996) reports more black hairs on his head, teeth and gums improved, the first improvement in his nearsightedness since early childhood, better night vision, improved elimination ("It feels great to be normal for the first time in 72 years!"). I'm getting similar health improvement reports from around the country. Even if all these are just the placebo effect, it's still worth the time and trouble. Have you built one yet?

Now I realize that most Americans have been reduced to gutless wimps by our compulsory school system, but a few hams seem to have survived the 12 to 16 years of brainwashing with their sense of curiosity not totally destroyed, so I have hopes that the Bioelectrifier, which may turn out to be the medical industry's worst nightmare (an inexpensive cure for expensive illnesses), will get a fair trial. In the meanwhile, we can expect the usual ridicule, denunciation and persecution of the pioneers.

Yes, there are some commercial suppliers of the plant growth stimulator for those for whom even this simple device is too much to whip together.

Will this simple gadget be able to cure AIDS, and help rebuild immune systems to counter cancer, lupus, Lyme disease, and a bunch of other illnesses? Well, I don't yet believe in miracles, but I'll be surprised if almost any chronic illness can't be cured by a combination of stopping the input of poisons into the body, providing it with the nutrition it has been designed over millions of years to work with, with some help from the Bioelectrifier, and maybe some magnets, as we learn more about how they work. Oh yes, add in some prayer, because that has been proven to help. And a reduction of stress, since every illness has a psychological component. If we treat the body right we should be able to get another 20-30 years of good dependable service out of it over today's average.

The Freon Hoax

Congress has done it to us again! Did you get sucked in, as did Congress and President Bush, on the Freon hoax? Remember all that total hogwash about Freon eating up the ozone. Well, just by the damnedest coincidence this brouhaha, pushed by the greenies, came along at the same time as DuPont's patents for Freon were expiring. Talk about serendipity! Talk about billions of dollars in profits!

Freon can no longer be made since our beloved government now classifies it in about the same category as cocaine. So now a new and less efficient refrigerant is being used. Care to make a wild guess as to what company owns the patents on it? Oh, you peeked.

It turns out that scientists tell us that Freon leakage was environmentally insignificant since the chlorine molecule involved is heavier than air and sinks instead of rises. The evaporation of sea water releases infinitely more chlorine. Maybe Congress can put a stop to that by desalinating the oceans.

Yes, and by another unbelievable coincidence, DuPont is a major contributor to greenie groups. Who says altruism doesn't pay off? Big! I defy you to cite any major corporate altruism that isn't profitable.

Congress is driven by big business, and big business is driven by profits, even if they have to bribe a few greenies along the way to help move Congress in the "right" direction. As I've mentioned, every industry I've gotten involved with has turned out to be crooked, once I got to know the players. Capitalism is the best system we've found, but it sure isn't perfect.

Well, you keep re-electing Congress, so smile when you are paying the bill for a Freon substitute.

School Costs

There are several benefits we expect to derive from being a citizen of a country. Like a set of laws and their enforcement which help us to live in peace with each other. Like protection from foreign attack. Like an infrastructure which allows us a good lifestyle. That might include services such as sewer, water, power, roads, food supply, clean air, law enforcement, firefighting, and so on. These are

Continued on page 38

LETTERS

From the Ham Shack

Les Hale W3LIV5. The December article by W8AHB on Nikola Tesla was certainly on the mark; he was clearly a great genius. As a licensed amateur for over 50 years, and electrical engineer for 44 years, I have never thought there was any argument about this, having learned his "rotating field" concepts in college in the early 1950s. I have always thought it was common knowledge that he was "right" and Edison "wrong" in the AC vs. DC debate.

However, I would question the need to knock Edison down to build up Tesla's reputation. Although not possessing the theoretical insights of Tesla, Edison did many notable things by applying the principles outlined in "A Perspirational Message" by W2NSD/1 in the same issue. It would appear that today this approach is still leading to advances in electrical science and engineering, although it is perhaps more widely used now in Japan where they still frequently take the approach of learning from everybody and trying everything to make new discoveries. Perhaps Tesla has suffered somewhat from the "mad scientist" image and the fact that he made one serious mistake in his ideas about the wireless transmission of power. I believe this is not quite as crazy as most people think, and could have been possible if the losses in the semiconducting region between the insulating lower atmosphere and conducting ionosphere had turned out to be much less. Actually, to get reasonable efficiency, the "Q" of the spherical cavity between the earth and the ionosphere would have to be extremely high. "Schumann resonance" measurements have shown this Q to be about 5, but Tesla could not have known this.

A "lossless" cavity would have had other implications for hams. Signals which easily propagated around the world many times would certainly lead to untenable QRM and "echo" effects, and entirely different communications systems would have evolved.

Orlo Hudson W5LVA. I am a long-time lifer reader. This is to suggest that you research and publish an article which will probably make that issue a collector's item.

I left 20m AM phone about 30 years ago and have been on 2m ever since. Now that I am retired, I would like to dust off some of that old equipment and put it back on the air, but there have been so many band changes and new services that I really don't know what bands I can work and what modulations are legal. I have an old Class A license—which they now call Advanced. I am not about to "upgrade." I was licensed in 1941!

How about publishing a comprehensive spectrum analysis of places where hams (not appliance operators) can build equipment, operate the equipment, and explore the science without being illegal.

Include all frequencies—not just the established ham bands. For example, the frequencies below 100 kc.

While you are at it, you might comment on these proposed projects: (1) A small linear amplifier to hang on a VCR and boost the channel 3/4 output to where it can be picked up throughout the house. How much power can you legally run? (2) A 1 kW transmitter centered on 1 mc, putting out true Spread Spectrum Modulation. The FCC can't receive the rig unless they are standing under the antenna with an untuned FS meter.

I am just full of such ideas, but I don't want to go to jail! I am not interested in a "rag chew" on some appliance; I want to build something different and test it...

Dennis L. Foster KK5PY. Thank you ever so much for such a great, unbiased, amateur radio magazine. I had been inactive in ham radio for years and had really forgotten what a great publication it is until I read a copy or two from a friend's collection.

Les Warriner WA7HAM. History Lesson—Battle Of Agincourt. The French, who were overwhelmingly favored to win the battle, threatened to cut a certain body part off of all captured English soldiers so that they could never fight again. The English won in a major upset and waved the body part in question at the French in defiance. What was this body part? The answer, which clears up some profound questions of etymology, folklore and emotional symbolism, is that the body part which the French proposed to cut off of the English after defeating them was, of course, the middle finger, without which it was impossible to draw the renowned English longbow. This famous weapon was made of the native English yew tree, and so the act of drawing the longbow was known as "plucking yew." Thus, when the victorious English waved their middle fingers at the defeated French, they said, "See, we can still pluck yew!" Over the years some "folk etymologies" have grown up around this symbolic gesture. Since "pluck yew" is rather difficult to say (like "pleasant mother, pheasant plucker," which is who you had to go to for the feathers used on the arrows), the difficult consonant cluster at the beginning has gradually changed to a labiodental fricative "f", and thus the words often used in conjunction with the one-finger salute are mistakenly thought to have something to do with an intimate encounter. It is also because of the pheasant feathers on the arrows that the symbolic gesture is known as "giving the bird." And yew all thought yew knew everything!

One of the perils of E-mail is being spammed with plucky stuff like this. However, it does answer a question I never thought to ask... Wayne.

Ron Hartoebben KBØPF. I received the current issue of *Cold Fusion* today and noticed your E-mail address. How have I missed that before, since I subscribe to *73* and *CF*? I recommend that you encourage E-mail submissions for your magazines. Publish your address more often. Maybe even develop a Web page. It should pay off for you. After all, you're already on AOL.

I enjoy your editorials. I use ideas from them often in my courses. Yes, I am a teacher (in a small parochial elementary school). I started teaching because I can afford to after retiring from another exciting profession.

The fellow who helped me most in ham radio was Bill Stocking WØVM, who wrote several articles for you. We used to test some of his antenna theories at my shack. I successfully encouraged him to try phone in lieu of his exclusive CW, and in his last few years he enjoyed all aspects of the hobby.

I am in the middle of three generations of ham radio, all in-laws. My father-in-law got his ticket in 1930 and is still active. We have great photos from his early ham days. My two sons-in-law are both hams and making names for themselves. My experiences have paralleled yours often. Even did a stint as local publicity director for Mensa.

Recently I helped a fellow develop a database for WW2 submarine vets and even found a couple local guys who were on the *Drum*. I hope someday to catch one of your talk show appearances. You ought to give some advance notice in your magazines, or better yet put it in your Web page. There I go again, giving you advice.

Number 21 on the list of my 73

most urgent projects is setting up a Web page... Wayne.

Bill Chatterly N1SGI. "Why do I have to study CW? I use SSB rarely, no RTTY, no SSTV, no repeater, no computer—I only use HF. 1 do not care what a resistor or a capacitor does."

I had to learn this as a requirement to get my license for HF. It is part of the hobby. Is not CW part of the requirement also? What shall we delete from the requirements next? Think about it. Good luck, FISTS!

Guy A. Matzinger KB7PNQ. One hundred fifty years ago the Russian liberal thinker, Alexander Hertzen, wrote that what he feared most was a "Genghis Khan with the telegraph." When Lenin seized power in Petrograd in 1917, his first objectives were the seat of government and the telegraph office.

When, several years ago, "Incentivised Licensing" defined the course of amateur radio, it became the central control and essence of the hobby—using telegraphy and high-speed code tests to decide operating privileges. This totalitarian control with its enormous ability to manipulate amateur radio has become increasingly static. However, opening shots in a war over who gets to dominate the hobby were fired in recent months. At issue is who shall control international rules and regulations for amateur radio—specifically Morse code testing. Those organizations who believe they are the icons of order—or each country?

With sphincter-tightening apprehension, pro-code advocates are lobbying and bullying the international community, warning of chaos and a possible collapse of amateur operations if Morse code testing requirements are removed as a *treaty* obligation. These mutterings hint that the established foundation of the hobby will be eroded if each country is allowed to set its own code testing standards—absurd—each country does that already. The real concern is that some democratic society may not want a code test for any class of license.

We must move away from the mental virus that Morse code is the basis that defines an amateur radio operator—as we moved, 60 years ago, from crank-starting a Model-T Ford to today's fuel-efficient cars. Pro-code organizations and media pundits, who support the closed-shop mentality of limiting participation, need to stop whining with nostalgia for a vanished world, implying that without a Morse code treaty requirement amateur radio is going to turn into a disaster. Denmark recognized the need to change and in July of 1996 reduced license classes from five to three and code testing to 5 wpm for any class of license. Once again the Danes lead the way—without calamity.

Have we become so accustomed to our freedoms being worn away by self-serving interest groups that we can no longer allow any other country to choose its own course of action? The value of democracy lies in its freedom to choose. Amateur radio operates as a microcosm of society and if it wishes to be a communications participant, and continue free use of the spectrum and all the valuable progeny of that gift, it must change. The dynamic future of this hobby depends on integrating tomorrow's technology with today's abilities.

If ever there was a case for social justice, eliminating international Morse code *treaty* requirements tops the list. I strongly urge each of you to write to: IARU FASC, c/o IARU International Secretariat, PO Box 310905, Newington CT 06131-0905—supporting the removal of Article §25.5 at WRC99 as a *treaty* obligation of administrations and the putting of fun back into amateur radio. Then, perhaps, we can have a secure tomorrow for the hobby. 73

QRX . . .

Help Wanted: Dayton Youth Forum

New York City—Educator Carole Perry WB2MGP will be moderating the popular Dayton Youth Forum on May 17th. She is looking for articulate, enthusiastic young people (8–18 years of age) who would like to be presenters. Please call Carole at (718) 761-5733 as soon as possible.

Scholarships for Amateurs

The Foundation for Amateur Radio, Inc., a nonprofit organization with headquarters in Washington DC, plans to administer 60 scholarships for the academic year 1997–1998 to assist licensed radio amateurs. The Foundation, composed of over 75 local area amateur radio clubs, fully funds five of these scholarships with the income from grants and its annual hamfest. The remaining 55 are administered by the foundation without cost to the various donors.

Licensed radio amateurs may compete for these awards if they plan to pursue a full-time course of studies beyond high school and are enrolled in or have been accepted for enrollment at an accredited university, college or technical school. The awards range from $500 to $2,500, with preference given in some cases to residents of specified geographical areas or the pursuit of certain study programs. Amateur radio operators, especially those in DE, FL, ME, MD, NJ, OH, PA, TX, VA and WI, are encouraged to apply.

Additional information and an application form may be requested by letter or QSL card, postmarked prior to April 30, 1997, from: FAR Scholarships, 6903 Rhode Island Ave., College Park MD 20740.

The Foundation for Amateur Radio, incorporated in the District of Columbia, is an exempt organization under Section 501 (C)(3) of the Internal Revenue Code of 1954. It is devoted exclusively to promoting the interests of amateur radio and those scientific, literary and educational pursuits that advance the purposes of the Amateur Radio Service.

Found in Penn Wireless Assn.'s *X-Mitter*, January 1997.

FCC Enacts Internet Morse Code Requirement

The FCC, under pressure to clean up the Internet—especially after the Communications Decency Act provisions regarding Internet content regulation were stricken as violating the US Constitution—has decided instead to create a Morse code requirement for Internet users.

Citing the success of the Amateur Radio Service and the general belief that its requirement for operators to pass a Morse code proficiency exam and other technical requirements has kept the ARS "clean," the FCC has decided to enact a 5 wpm requirement for all Internet users. They are leaving open the issue of whether there should be a "codeless" class of Internet user and are soliciting comments on the proposal. Presumably, a "codeless" user would be restricted to Web pages published by household magazines and kitchen equipment suppliers, for example.

Persons wishing to develop Web sites that have actual content, as compared to just links to other Web sites, must pass a 20 wpm Morse proficiency test in HTML and the Java programming language, and show that they have mastery of at least one human language such as English or Esperanto.

The FCC, which lacks budgetary authority to implement the testing program, has stated that it intends to create Volunteer Examiner programs for Internet applicants.

From the *ARNS Newsletter*, February 1997; originally in *The Long Wire*, November 1996; special *merci* to French Ministry of PTT spokesman A. Prel FØOLE.

Hams on Duty in Western US Flooding

Ham radio has pitched in to help in the wake of serious flooding in the western US. In California, flooding 50 miles north of Sacramento resulted from a week of torrential rainfall. Tim Tribble JD6MDV, of the Sacramento CA City Fire Reserve RACES Operations Center, reported that his group was activated at noon on Friday, December 27th, and had been on 24-hour duty for an extended period thereafter. RACES operators have provided supplemental communications for the Fire Department, including relaying information about water levels at area dams. The hams also have been providing support services, and have even delivered food to out-of-state mutual aid groups.

Tribble reported that up to 40 area amateurs had been manning the command post. Other command posts were located at the Wilton Fire Department and at Station 59 in the Murietta/Sloughouse area of California.

One Saturday, seven operators were dispatched to the city of Marysville to assist the Department of Fish and Game in assessing livestock care needs. Another 10 were sent to aid the Red Cross in damage assessment.

Ham radio has also been assisting in flood recovery efforts in the northwest, including Oregon, Washington, and Nevada. In Oregon, long-distance telephone service to the Ashland-Grants Pass vicinity in the extreme southwestern portion of the state went down when a fiber optic cable was severed. Ham radio took over, linking the county via HF with the state emergency operations center in Salem. Oregon SEC Lew Williams WD7NML said Jackson and Josephine counties were the hardest hit. In Jackson County, hams helped provide communication at shelters. Williams said hams also pitched in during sandbagging operations. In Nevada, Dick Creley KJ7UK of Gardnerville reported hams were activated on New Year's Day and provided secondary communications for the Douglas County Sheriff's Department, the Emergency Management Office, and two shelters that housed some 50 residents. The approximately 30 hams in Douglas County and Carson City put in a total of 350 work-hours. Creley said damage was extensive, and the cities of Minden and Gardnerville were isolated. Bruce Pfeiffer N7CPP of Carson City said telephone service remained in operation, limiting the need for ham radio communication support. His wife, Sue Pfeiffer N7PRF, and Reed Ross W7HOP manned a station at the Carson City EOC, while he and Jo Ann Paul N7MBM, manned a station at a local Carson City shelter.

In Yerington NV, 17-year-old Carrick Dunn KB7OBE provided the only communication link between his town and the outside world.

TNX *The GCARC Wireless*, January 1997.

ARLSØ16 Ham Radio on Space Station

A foundation has been laid to give amateur radio a permanent presence in space. Late last year, amateur radio delegates from eight countries—Russia, Japan, Germany, Great Britain, Italy, Canada, France and the US—met at the NASA Johnson Space Center in Houston TX to map plans to include a permanent ham radio station aboard the International Space Station, to be tended by station crew members.

From the United States, members of the SAREX Working Group, officials from NASA, US representatives of the Russian *Mir* Amateur Radio experiment and members from the Johnson Space Center Amateur Radio Club attended the meetings November 4th and 5th, chaired by Roy Neal K6DUE. ARRL Vice President Joel Harrison W5ZN (ex-WB5IGF) represented the League at the gathering. SAREX Working Group member Rosalie White WA1STO, of the ARRL Headquarters staff, was among those on hand. The delegates jointly developed a draft memorandum of understanding to promote the development of Amateur Radio on the International Space Station—to be known as ARISS.

The ARISS group will provide for the planning, coordination and performance of amateur radio projects on the space station, similar to the way the SAREX Working Group currently coordinates amateur radio activities on many space shuttle missions. AMSAT and IARU organizations in each of the eight countries are to review and consider approving the memorandum of understanding. In the US, this includes AMSAT-NA and the ARRL

The AMSAT-NA Board unanimously approved the memorandum of understanding at its November 11th Board of Directors meeting in Tucson AZ. Once the memorandum is finalized, AMSAT-NA President Bill Tynan W3XO has been given authority by the board to sign it. AMSAT-NA Vice President for Manned Space Frank Bauer KA3HDO congratulated the international ARISS team for a job well done. "We look forward to a truly cooperative international venture on the International Space Station," he said.—de ARRL HQ, via Keith N3LDF.

TNX to *The Ham Arundel News*, January 1997.

Continued on page 84

The Hale-Bopp Comet and Its Controversial Tale

Build the Cosmic Crystal Set and listen in!

Thomas M. Miller WA8YKN
314 South 9th Street
Richmond IN 47374
E-mail: thomil@infocom.com

April 1997 marks the closest approach of the long-awaited Hale-Bopp comet, discovered on July 22, 1995 by amateur astronomers Alan Hale and Thomas Bopp. Although comets are notoriously unpredictable, this one shows every sign of becoming a bright, naked-eye object, perhaps even visible in the daytime! At the very least, the arrival of Hale-Bopp will be an event to remember.

Brightness, however, may not be the most interesting aspect of this object. Riding with Hale-Bopp is an intense storm of rumors and controversy which seems to intensify in direct proportion to the comet's proximity.

The first indication that Hale-Bopp was an "unusual" comet was its discovery: most comets are discovered only a few months away from their closest approach to the sun. The comet Kohoutek set a record in 1973, first seen seven months out. Hale-Bopp was first spotted an incredible 21 months away from Earth, an astounding 666 million miles out, beyond the orbit of Saturn! No comet ever discovered would be visible at that distance, even through the largest telescopes in the world. Hale-Bopp, however, was large and bright enough to be seen by *two* amateurs on the *same night... by accident!* Since the discovery, astronomers have searched old photographic plates and discovered that one shows the (then undiscovered) comet, an astonishing 40 *months* away!

"Hams, known to wear hats sprouting antennas, don't embarrass easily, so in this case it's clearly up to us."

Not only does Hale-Bopp appear to be the largest and brightest comet ever discovered, but its behavior defies explanation. The comet is far brighter than it should be at that distance from the sun, and it has regular outbursts of brightness, accompanied by huge jets of gas, dumping carbon dioxide at the rate of several tons per second. These outbursts occur every 19 days.

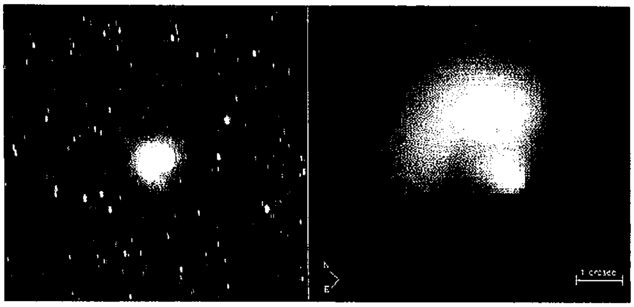


Photo A. The HaleBopp comet as seen by the Hubble space telescope on September 26, 1995.

The controversy surrounding Hale-Bopp really began to heat up on November 16, 1996. Chuck Shramek, radio host and amateur astronomer, released a photograph of the comet which clearly showed a large object moving with Hale-Bopp. This object was round and sharp, with a curious "line" through it that made it resemble the planet Saturn with the rings on edge. The image soon found its way onto the Internet, and all "Hale" broke loose!

Chuck was immediately and savagely attacked and denounced by astronomers everywhere, who claimed that the object in question was an 8.5 magnitude star, and the "line" was a diffraction spike caused by the optics in Shramek's telescope. The object in the photograph, however, was clearly brighter than magnitude 8.5, since it was at least as bright as the 4th magnitude Hale-Bopp... and Chuck's telescope does not have a secondary mirror support, and therefore does not create "diffraction spikes" on bright objects. Since that time, other photographs have surfaced from the Japanese National Observatory and others which also show a "companion" traveling with the Hale-Bopp comet.

If Hale-Bopp has a "companion," it would not be that unusual. Most objects in the solar system large enough to have any gravity at all have them. Even the tiny asteroid "Ida" has a companion, a small chunk of rock that orbits the asteroid (although why it was not named "Ho" is a great mystery!). Why, then, does the "Hale-Bopp companion" spark so much outrage and denial among astronomers?

Maybe it's the radio signals!

That's right, radio signals! Starting about the same time as Shramek's photo controversy, rumors of RF emissions

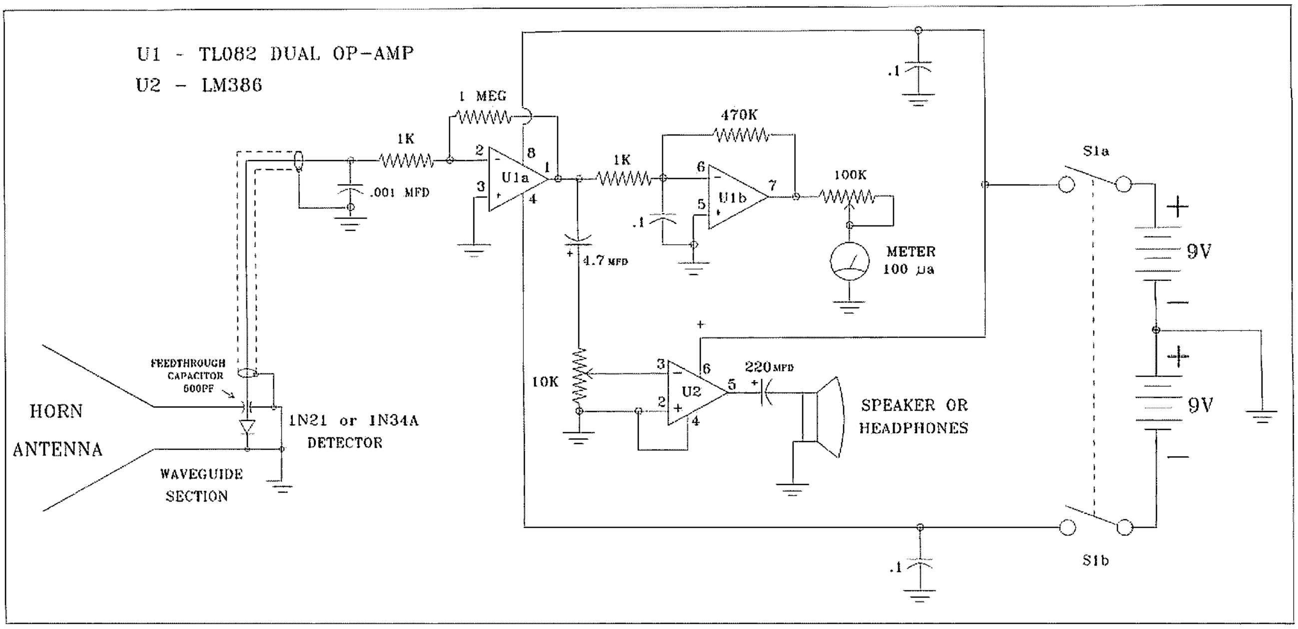


Fig. 1. Schematic diagram for the Cosmic Crystal Set. A sensitive diode detects the microwave signals that enter the waveguide.

from Hale-Bopp began to surface. Some of these emissions were broadband, clearly natural "noise," but others were reported as narrowband, high-intensity signals... *modulated* signals! Radio talk show host (and ham) Art Bell played a tape of one of these signals on the air, and added that a professional astronomer (who did not want his name mentioned) confirmed the reception of "unambiguous signals," not from the comet, but from the *companion!*

As you might expect, this announcement brought the controversy to a new level. Theories to explain the signals began to fly, ranging from some natural-but-unexplained byproduct of the intense gas jets to advanced extraterrestrial beings. Astronomers have refused to comment on the signals at all.

Friends, no professional scientist is going to touch this one, and we can't blame them. Scientists live in a political world, and their livelihoods depend on credibility—and funding. The mere mention of a phenomenon tainted with rumors of "giant spacecraft" and "little green men" assures that they will ignore it. It's a sad fact that, should some E.T. someday fly by and send us some sort of greeting in passing, we might never know, since the professionals would be too embarrassed to acknowledge it!

Hams, known to wear hats sprouting antennas, don't embarrass easily, so in this case it's clearly up to us. Best-selling author Whitley Strieber commented, on the Art Bell show, that hams should monitor Hale-Bopp for radio activity, just as amateur astronomers are observing it optically. I fully agree; whether there are E.T.s involved or not, Hale-Bopp is the most unusual visitor to the inner solar system in our lifetime, and won't return for 3,600 years. We won't get a second chance. Besides, it's a challenge right up our alley, and it sounds like fun!

The "Cosmic Crystal Set"

There has been very little technical information to go along with the Hale-Bopp signal rumors. There have been several references to "K-Band," which only narrows it down to 24 billion possible frequencies. We can, however, make some assumptions: *If* these signals are from intelligent beings, and *if* they are intended for us, then it's safe to assume that they will be easy to receive.

***Photo B**. Is this a hoax? This photo, from an anonymous source on the Internet, shows the Hale-Bopp comet with its purported companion.*

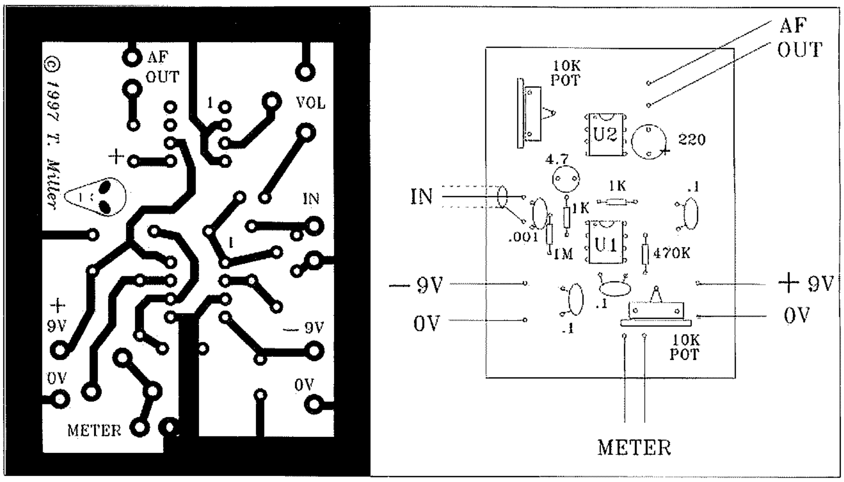


***Fig. 2**. Printed circuit board pattern and component layout guide for the Cosmic Crystal Set.*

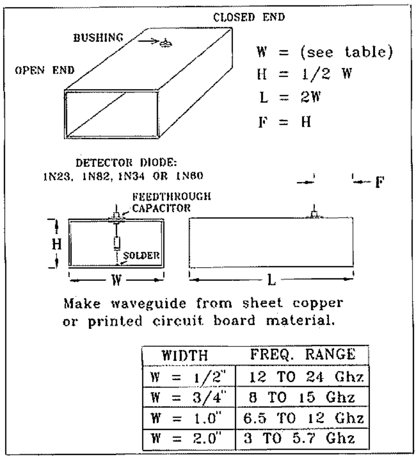


Fig. 3. Waveguide and crystal diode detector construction details.

They would also probably utilize microwave frequencies where antennas behave much like optics, making efficient, tightly focused transmissions possible. Given that, K-Band doesn't sound like a bad choice, but there's no reason not to listen to the entire microwave spectrum, and perhaps UHF and VHF as well. A voltage-tuned TV tuner can sweep from 54 to 800 MHz, and, with the IF displayed on an oscilloscope, makes a sensitive spectrum analyzer. TVRO systems could be used, using the baseband video output to drive a good HF receiver. Surplus radar detectors have sensitive superhet front ends for both X- and K-Band. All these things can, and should, be used—but what if you don't have access to any equipment at all? No problem. You *build* something!

Fig. 1 shows the schematic diagram of the "Cosmic Crystal Set." This simple microwave receiver is nothing more than a sensitive germanium diode detector in a short section of rectangular waveguide. The diode rectifies the microwave energy which is bypassed for RF by a small ceramic feedthrough capacitor. The resultant DC (and audio, if the signal is modulated) is passed to the input of the amplifier.

The amplifier uses a TL082 dual op-amp for two stages of DC-coupled gain. The first stage amplifies the incoming signal, and the second serves as a meter driver. The 100-microamp meter provides an indication of signal strength. If you use a zero-center meter, it won't matter which way you connect the diode across the waveguide.

A 4.7-microfarad capacitor is used to pick off any audio present on the signal, where it is boosted by an LM386 audio amplifier. It can drive headphones or a small speaker. The circuit is powered by two 9-volt batteries.

Fig. 2 shows the printed circuit board and parts layout for the amplifier. The parts are available from Radio Shack™, as well as any good electronic supply house. If there is any interest, I can provide circuit boards for those who can't make their own.

When completed, this device is actually a very sensitive field-strength meter. The only frequency-selective component is the waveguide itself. **Fig. 3** shows the construction of the waveguide, which can be made from sheet brass, copper, or tin. Printed circuit board material works well, also.

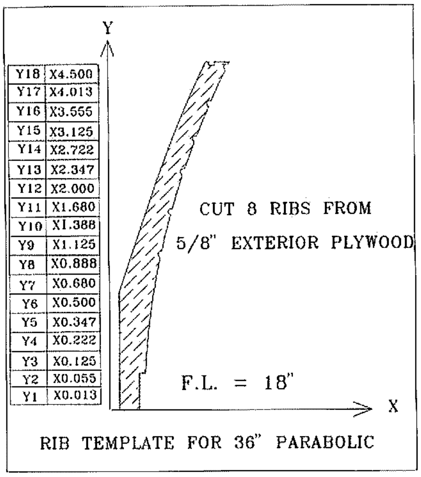


Fig. 4. Rib pattern for the three-foot-diameter parabolic dish. The focal length is 18 inches.

A waveguide is actually a high-pass filter. The cutoff is the point where the wavelength is equal to the width of the guide. Waves shorter than half the guide's width will pass through as well, but the mode of propagation is uncertain, so waveguides are selected in different widths for various bands of frequencies. The table at the bottom of **Fig. 3** shows the proper waveguide width for the different microwave bands. All other dimensions are scaled to this width, as shown. By building one amplifier and a number of waveguide/detectors, it is possible to monitor virtually the entire microwave spectrum.

These waveguides will receive signals of only one polarization, so some method of rotating the horn 90 degrees should be employed to catch both horizontal and vertical signals.

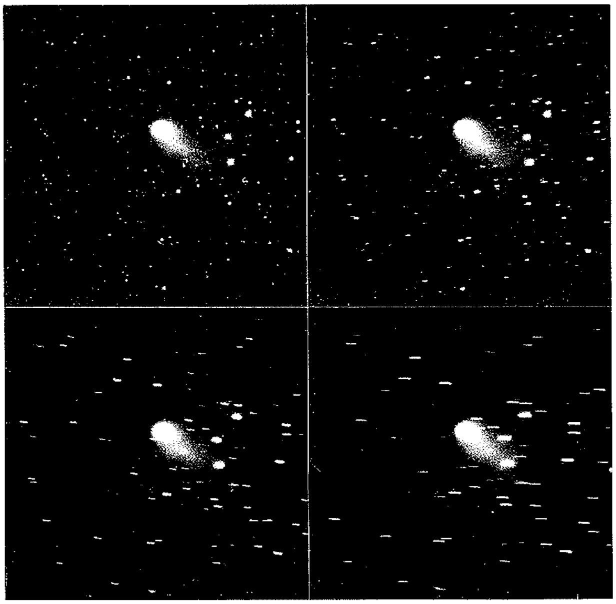


***Photo C**. The Hubble telescope captures the Hale-Bopp as it hurtles toward our solar system.*

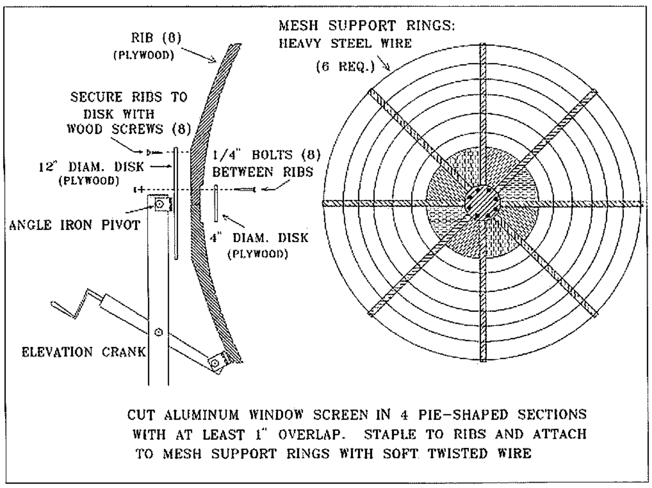


Fig. 5. Construction details of the three-foot dish. The framework is covered with aluminum window screen.

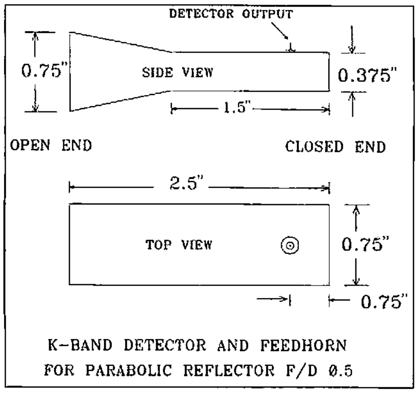


Fig. 6. Dimensions for the K-Band detector and feedhorn. This feed will work with other dishes with a focal ratio of 0.5 to 0.7.

Home-brew microwave antennas

Since diodes have loss, we have to offset this with antenna gain. The most popular microwave antenna is the parabolic reflector. A dish in the 2- to 4-foot range should be ideal for K-Band signals; anything larger would have too narrow a beamwidth to be of much use. **Fig. 4** shows a rib template for a 3-foot parabolic reflector with a focal distance of 18 inches. You can scale this drawing up directly, or lay out your own pattern by plotting the X and Y coordinates from the table and connecting the dots.

Fig. 5 shows how the ribs are assembled to form the antenna framework. The ribs are mounted on a 12-inch plywood disk, while a 4-inch disk is mounted in front. Through-bolts hold the two disks together, providing a strong support for the ribs. I've used this technique for quite a number of antennas, the largest measuring 12 feet.

The feedhorn is shown in **Fig. 6**. Essentially the same as the waveguide/detector shown in **Fig. 3**, the waveguide is extended an inch, while the narrow dimension is flared to match the 3/4-inch width, providing a square aperture. The diode is mounted half a guidewidth from the shorted end. The dimensions shown are for K-Band signals, but can be scaled for other bands.

Sometimes surplus dishes turn up surprisingly cheap, and most often the focal distance of these dishes is very short, making them hard to feed with a conventional horn. **Fig. 7** shows a simple way around this problem: Rather than flaring the waveguide into a horn, the corners of the open end are trimmed back at an angle and a "dispersal pin" is added in

the center of the opening. I've used this to feed dishes with F/D ratios as small as .25 with great success. The beamwidth will vary somewhat with the angle, but 20 degrees seems to work pretty well. For K-Band, a piece of 14-gauge wire will work for the dispersal pin; make it thicker at lower frequencies.

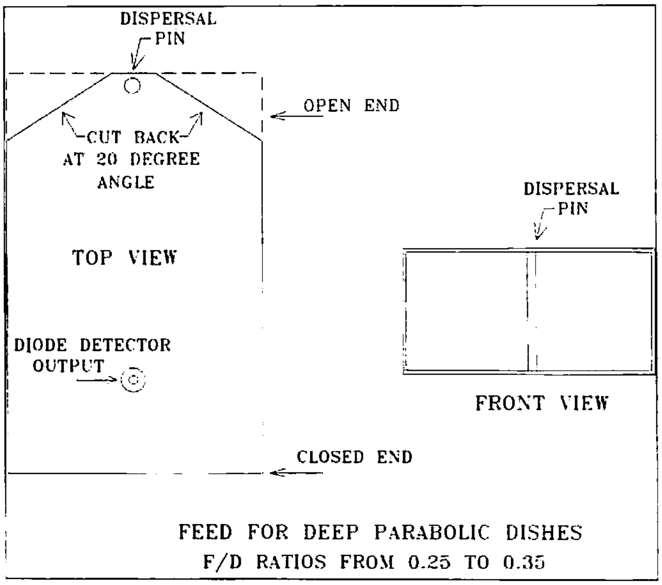


***Fig. 7.** By trimming the open end of the waveguide as shown, short-focal-length surplus dishes can be easily fed.*

All right, you don't have a parabolic lying around, and building one takes too long. Now what do we do? **Fig. 8** shows a simple alternative that anyone can make with a yardstick and a pocketknife. It's a "Giant Pyramidal Horn" antenna, and it can be made from aluminum-foil-backed Styrofoam™, available in standard (4- x 8-foot) sheets at any lumberyard or building supply store. In essence, the horn has as much gain as a dish of the same area, so the 12-inch by 14-inch horn shown might be the equivalent to an 18-inch dish. There is no reason, however, why it cannot be made much larger: Just taper the open end smoothly to whatever size waveguide you are using. The foam can be glued with white carpenter's glue and reinforced with toothpicks. The inside corners can be covered with aluminum tape.

Well, there you have it... simple microwave equipment that you can build tonight, and listen to Hale-Bopp on tomorrow! If you hear anything, send me your reports and I'll post them on my web site, The Martian Archives. If you have Internet access (and you should!), you can keep an eye on this site to see what others are hearing. The URL is: http://www.infocom.com/~thomil/

Afterword

Okay, so you built the Cosmic Crystal Set, and Hale-Bopp came and went with nary a sign of Extraterrestrial Biological Entities. Now what?

Well, you might as well keep listening. After all, there are countless microwave signals of all types within reach of the amateur, and no doubt

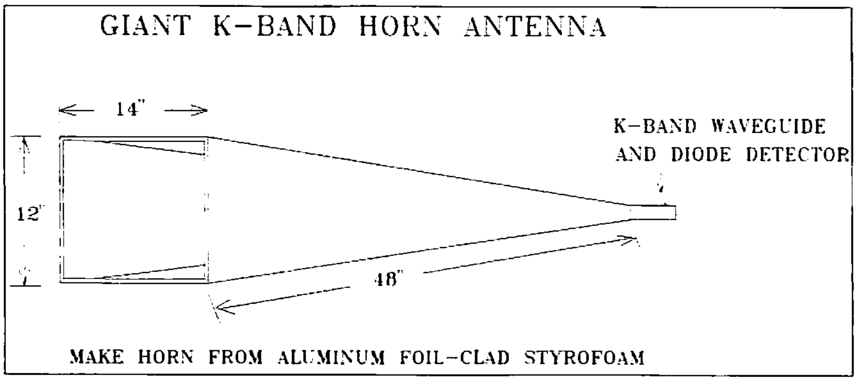


***Fig. 8.** The giant pyramidal horn is more bulky than a parabolic reflector, but is far less critical and easier to build.*

certain people wouldn't enjoy knowing that you are listening to them. What better reason is there for listening? Also, you now have a very sensitive field strength meter—connect a diode across a two-meter dipole and it should make a good sniffer for transmitter hunts. Or, you could connect the coil of an old relay to the input, making a very sensitive magnetic field monitor.

And if the E.T.s didn't send you their greetings *this* time, who knows what will show up tomorrow?

I welcome your comments... send E-mail to thomil@infocom.com. Should you prefer to correspond via disgruntled government employees, please include an SASE.

Internet resources: the World Wide Web

http://www.infocom.com/~thomil/ —"The Martian Archives"—This is the author's home page. There is an area devoted to the Hale-Bopp monitoring project.

http://www.stsci.edu/pubinfo/pictures.html —This is the home page of the Hubble Space Telescope. There are Hale-Bopp images here, but nothing new has been posted since early November.

http://newproducts.jpl.nasa.gov/comet/ —NASA's "Hale-Bopp Home Page." Keep in mind that this is from the guys at Never Actually Say Anything... and this is probably the *slowest* web server in the universe.

http://www.neosoft.com/~cshramek/ —Home page of Chuck Shramek, who started all the controversy by imaging the "companion."

http://www.strieber.com —Whitley Strieber has devoted an area to late-breaking comet news. Whitley first mentioned using amateur radio operators to monitor Hale-Bopp.

http://www.artbell.com —Home page of Art Bell, amateur radio operator and late-night radio host. Art has a lot of comet information on-line, as well as many other interesting topics.

TV/VCR Tuner Applications

The first of a three-part series.

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

With the increased availability of used TV/VCR tuners, electronic projects abound for the ham experimenter. Numerous receiver and test equipment projects can be developed around TV/VCR tuners, which are the RF front ends of TV receivers and VCRs. Modern tuners are electronically tuned, which makes them mechanically stable and relatively easy to use. "Cable ready" tuners have a typical frequency range from about 45 to 900 MHz, which covers most of the desired VHF and UHF spectrum.

A list of projects supported by TV/VCR tuners could be quite extensive. A few of them are: wideband frequency converter; wideband receiver; wideband signal generator; sweep generator; standard deviation signal source; spectrum analyzer; and tracking generator. Here's a little more insight into each project.

Wideband frequency converter and receiver

These two projects are closely related in that the tuner performs the same function for each, but a different receiver is used after the tuner. Not all tuners are alike, nor do they cover exactly the same band of frequencies, but they do provide the capability of receiving a band of frequencies ranging from about 45 to 900 MHz. This band of frequencies is the typical frequency range covered by TV channels 2 through 83. Although the upper three channels have been transferred to cellular phone and other business applications, some tuners may still approach 900 MHz. There will be little loss in tuner desirability due to the band change, however.

> ***"If you don't plan to save your tuners for your projects, give them to me—I'll find a use for them!"***

The basic difference between the converter and receiver applications deals with the receiver used following the tuner. A converter is a stand-alone box which outputs a single frequency (47-63 MHz) to a receiver where the rest of the receiver functions are supported. The 47-63 MHz output is referred to as the intermediate frequency (IF) of the tuner. The tuner and receiver functions are contained within one box to provide a complete wideband receiver.

Signal generator

Within every TV/VCR tuner is a local oscillator which is intended to mix with a received signal to produce an IF. The oscillator operates typically on the high side of the received signal and is offset in frequency by the value of the IF. Normally, the oscillator signal can be accessed and used as a signal source with the support of tuning control and power. Thus a signal generator is born capable of covering the band from 90 to 915 MHz.

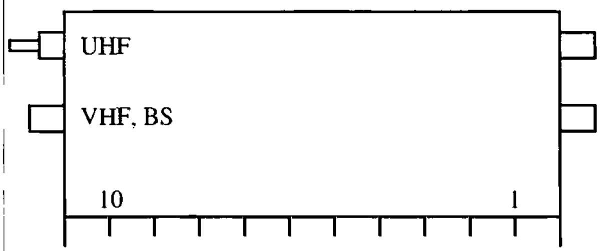
Sweep generator

A sweep generator is used to sweep a frequency across a resonant device or circuit with the objective of observing the profile of the circuit's response as a function of frequency.

With the oscillator in a tuner being used as a signal generator, a sawtooth voltage waveform is applied to the tuning voltage line, causing the oscillator to sweep across a band of frequencies. The frequency spread is controlled by the amplitude of the sawtooth, while the sweep rate is controlled by the repetition frequency of the sawtooth.

Standard deviation signal source

When a signal is frequency modulated with a sine wave audio signal, the produced carrier from the generator will



PIN	FUNCTION
1	IF
2	PLL +5 V
3	BM +12 V MIXER
4	N/C
5	BH VHF HIGH
6	BL VHF LOW
7	AGC 0-7 V
8	BS SUPER BAND
9	VT TUNING VOLTAGE 0-29 V
10	BU UHF BAND

Fig.1. Typical connector configuration.

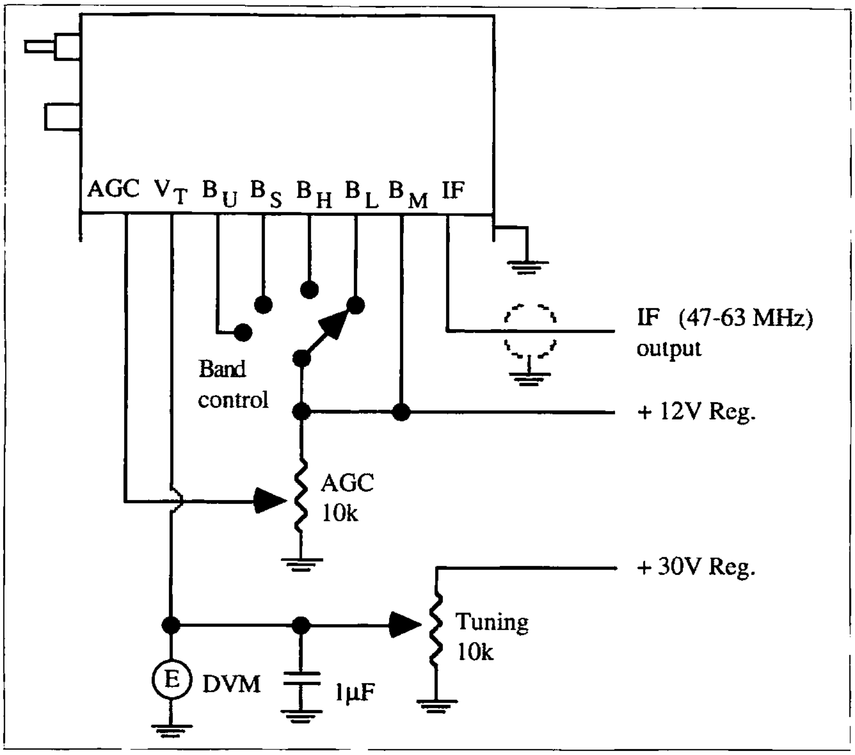


Fig. 2. Test circuit.

null in exact correlation with the amount of frequency deviation. The audio signal as modulation is applied to the tuning voltage line FMing the carrier. The amount of deviation is controlled by the amplitude of the sine wave modulation. With the use of a Bessel Function chart or a carrier null equation, the carrier null can be predicted for accurate frequency deviation measurements or as a standard deviated signal source.

Spectrum analyzer

A spectrum analyzer utilizes the sweep function of the sweep generator, but functions as a receiver. The output of the spectrum analyzer is displayed on an oscilloscope. Adjusting the sweep width allows viewing of a selected portion of frequency spectrum. One of the many uses of the spectrum analyzer is to allow the examination for purity of a transmitted signal. If the transmitted signal is "dirty," numerous spurious signals will be observed within the transmitted spectrum and centered on the signal.

VT	BL	BH	BS	BU
0	45	82	156	406
5	71	139	214	539
10	92	160	269	646
15	106	180	320	762
20	114	200	357	850
25	118	205	370	899
28	119	207	376	915

Table 1. Typical frequencies vs. voltage table.

Tracking generator

A tracking generator utilizes the sweep generator function and is used in conjunction with the spectrum analyzer to profile the frequency response of a resonant circuit. In operation, the tracking generator operates precisely on the received center frequency of the spectrum analyzer and remains in sync as it is swept across any selected portion of spectrum.

ID your tuner

Building a receiver is generally a pretty complex project, but with TV/VCR tuners available from junked equipment, the complexity is cut to less than half—making the building of a receiver feasible. Let me make you a

proposition: If you don't plan to save your tuners for *your* projects, please give them to me so that I can find a use for them. I'll even test them for you, should you desire.

The electronically-tuned TV/VCR tuners cover a wide band of frequencies, typically from 45-900 MHz, broken into 3-4 tuning bands depending on whether the tuner is "cable ready." This indicates that a super band is included. If the tuner is marked, the band indications will be BL (low VHF), BH (high VHF), BS (super band), and BU (UHF). Within the 45-900 MHz range are four ham bands, aircraft (both civilian and military), public service, hospitals, weather, taxicabs, phone systems, all TV channels, and many others.

To salvage a tuner from its resident equipment, you should observe and transfer any pin markings on the PC board to the tuner to make pin identification easier. But even without available markings, it is reasonably easy to identify the function of each pin. The specific difference between a TV and VCR tuner is the output (IF) frequency. For VCRs, the output is 63 MHz; for TV tuners, the output is 47 MHz. But even with the frequency difference, the tuners can be used alternately if need be. The supporting circuit design remains the same regardless of the IF used by the tuner.

It is best to test the tuner on the workbench prior to building it into a project. The more you know about the tuner, the easier it is to develop the supporting circuitry. All electronically-tuned tuners have pretty much the same voltage requirements, which are as follows: mixer/oscillator, 12V; tuning, 0-28V; AGC, 0-7V; band selection, 0V off and 12V enable; PLL, 5V; and AFT, ±1V.

During the visual examination the various connectors need to be identified. For a VHF/UHF tuner, there will be two antenna connectors. The UHF connector will be two parallel pins and the VHF/super band will be a phono connector. Both antenna connectors will be on the same end of the tuner. On the opposite end of the tuner, one or two more phono connectors may be present. These are arranged close to the local oscillator and provide I/O access between the oscillator and the PLL circuit.

The multiple connector pins along one edge of the tuner provide access to the various tuner control circuits as shown in **Fig. 1**. It must be clearly understood that the pin configuration will be unique for each available tuner. Starting from the oscillator end of the tuner, the pins are typically as follows: IF output; PLL; mixer/oscillator; blank pin; band control; band control; AGC; band control; tuning voltage; and band control. Some tuners have an AFT terminal which is normally used for fine tuning.

Testing a tuner is straightforward in nature, but does require a receiver covering the tuner IF; two regulated power supplies; two 10k pots; a DVM; a VHF and/or UHF antenna; and a couple of short-length clip leads having small-size clips. For UHF, two wires, each about three feet long, can form a rabbit-ear-style antenna; a 146 MHz antenna will work well for VHF.

Fig. 2 shows a typical circuit for testing a tuner. The procedure for tuner setup is as follows: Set the receiver to 47 MHz (or 63 if a VCR tuner is used). Connect the antennas to their respective connectors. Set one power supply to +12V and connect the voltage directly to the mixer/oscillator pin. The negative voltage side connects to the tuner case. Connect one 10k pot across the 12V supply and adjust the output to 5-6 volts. Connect the wiper to the AGC pin. Connect the second pot across the second power supply and set the supply to +30V output. Adjust the pot (tuning voltage control) to 0V. Connect the pot wiper and a DVM to the tuning voltage pin. Connect a clip lead from the +12V output and temporarily attach it to one of the band control pins. During testing, the AFT terminal, if present, may be grounded.

Open the receiver squelch and very slowly adjust the tuning voltage from 0V to maximum, and back again. If you hear a station, stop to record the tuning voltage value and the band control pin number. If the station can be identified by a service, then it should also be noted. Critically adjust the AGC voltage for maximum sensitivity upon hearing the first station. Measure and record the AGC voltage and leave it set for all remaining tests. Repeat the tuning procedure for each band control pin.

F (MHz)	SERVICE
46	phone
49	phone / baby monitor
50	6 meter ham
88	FM BC
108	FM BC
116	aircraft
136	aircraft
146	2 meter ham
150	public service / taxi
162	weather
222	1-1/4 ham
230	mil. aircraft
445	70 cm ham
800	public service
886	phone
902	commercial / ham

Table 2. Frequency spectrum.

When checking the bands, use the chart shown in **Table 1** as a guide. For the UHF band, the only signals heard on the top of the band will be cell phone, and the tuning voltage will be in the range of 20-28 volts.

From the band control and tuning voltage information, a tuning voltage vs. frequency chart can be developed in a manner similar to that shown in **Table 1**. After the tuner has been tested and the voltage requirements noted, select and build a project around the tuner. Tune the spectrum as shown in **Table 2**. Again, if you aren't going to use the tuner, give it to me.

Next time: frequency converter, mobile power.

Build a Colloidal Silver Generator

Do-it-yourselfing has always been the heart of hamdom.

Thomas M. Miller WA8YKN
314 South 9th Street
Richmond IN 47374
E-mail: thomil@infocom.com

The discovery of antibiotics is often considered the most important breakthrough in modern medicine. Beginning with the introduction of penicillin in the early 1940s, one disease after another fell to the constant onslaught of new and more powerful drugs. Armed with this powerful new arsenal, many doctors believed that the end of all infectious disease was within their grasp.

Bacteria, however, are difficult to conquer. The oldest life form on the planet, they have survived, and thrive, virtually everywhere on Earth precisely because they are adaptive—capable of changing themselves in response to a hostile environment.

When bacteria are constantly exposed to antibiotics, they will do what they do best—adapt. If only a single bacterium manages to survive an antibiotic attack, that organism can produce over 16 *million* offspring within 24 hours, and each of these will inherit the ability to resist that drug.

In the late 1970s, new strains of disease-causing organisms began to emerge that were resistant to antibiotic drugs. Researchers have tried to counter by developing new and even more powerful drugs, but it appears to be a losing battle. More and more bacteria are becoming MDR (Multi-Drug Resistant), and new drugs are becoming more difficult and expensive to produce. And, while a new drug may take a decade to reach the pharmacy shelf, bacteria can mutate in hours.

"Unlike antibiotic drugs, the use of silver does not produce resistant strains of bacteria."

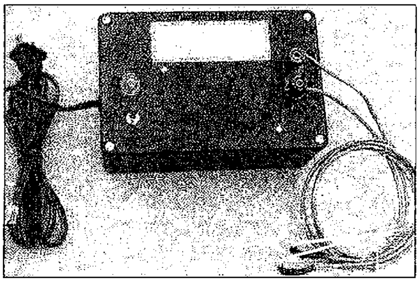


Photo A. *The Colloidal Silver Generator, with pure silver electrodes. Pure silver colloid, a natural antibiotic, can be made for the cost of distilled water!*

Don't despair!

Fortunately, alternatives to antibiotic drugs do exist, and the most promising is silver. Commonly used prior to 1938, silver is a natural broad-spectrum antibiotic. In fact, while most antibiotic drugs are effective against a select few types of bacteria, silver is known to kill over 650 different disease-causing bacteria, and many viruses as well—yet silver is completely non-toxic. Unlike antibiotic drugs, the use of silver does *not* produce resistant strains of bacteria.

Like other metals, pure silver is generally found in the crystalline state. The body, however, cannot utilize crystalline metals; they must first be transformed into the *colloidal* state. A colloid consists of extremely tiny particles of a substance, suspended (not dissolved) in pure water. Each particle contains only about 15 atoms, and is hundreds of times smaller than a red blood cell. Colloidal silver can be easily absorbed and utilized by the body to fight bacterial and viral infections. Some doctors believe that silver is necessary for proper operation of the immune system.

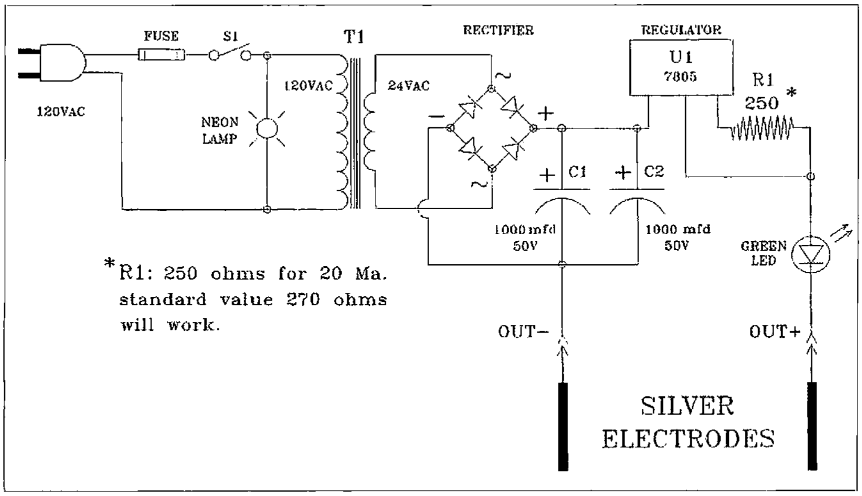


Fig. 1. *Schematic diagram of the Colloidal Silver Generator. Regulator U1 provides a constant 20 milliamps to the pure silver electrodes. The green LED indicates current flow.*

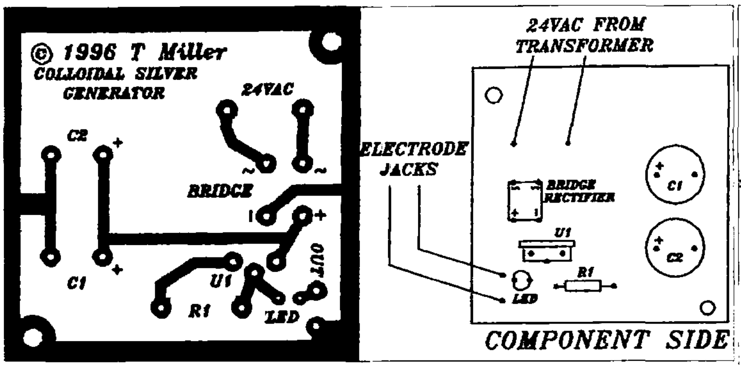


Fig. 2. Printed circuit board pattern (foil side) and component layout. Boards are available from FAR Circuits.

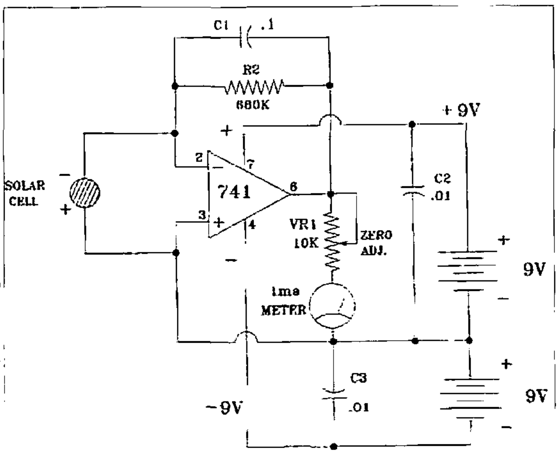


Fig. 4. Schematic diagram of the light meter used to check silver concentration. The circuit measures scattered laser light.

Before 1938, colloidal silver was manufactured by a mechanical method: the silver was actually crushed and ground to fine particles. Unfortunately, it is nearly impossible to grind a substance to the size of atoms, so this method produced a very poor-quality colloid. Today, colloidal silver is produced by an electric process that results in extremely fine particles. Since these particles carry an electric charge, they repel one another and remain suspended in an electric field. This helps prevent the silver particles from settling to the bottom.

It couldn't be easier...

A daily tablespoon of colloidal silver can be taken orally, either alone or mixed with water or juice. It can be absorbed directly by simply holding a small amount in the mouth for a minute or two. It also promotes healing and prevents infection when used externally on cuts, scrapes and rashes. Colloidal silver can be sprayed on kitchen countertops, added to laundry and bath water, used to sterilize canning jars and lids, and even added to your pet's water dish to prevent bacterial growth.

The one drawback to this amazing substance is the cost. Colloidal silver is available in most health food stores as well as by mail, but the average cost is between $5 and $10 per ounce! This high cost prohibits most of the applications we've mentioned, since it would cost $100 to fill an average spray bottle. Also, tests have shown that the quality and purity of the colloidal silver on the market varies widely, and it's hard to tell exactly what you're getting.

The answer to these problems is to do what hams do best—make it yourself! The circuit required to generate a silver colloid is simple, and once built, will make hundreds of gallons for virtually the cost of the water.

"...Silver colloid solution may be the most useful health enhancement tool in your environment." — Bob Beck

A few months ago, a reader sent me a paper written by Physicist Bob Beck. In this paper, Dr. Beck described his circuit for making colloidal silver, which consisted of three 9-volt batteries connected to provide 27 volts, a 28-volt 40-milliamp light bulb, and two electrodes made of pure silver wire. The light bulb, wired in series with one electrode, acted as a ballast resistor to limit the current. Since distilled water does not conduct electricity very well, a tiny amount of pure salt is added until the bulb produces a "dim glow." Five minutes of this will, according to Dr. Beck, produce a high-quality colloidal silver concentration of 5 to 7 ppm (parts per million).

I built Dr. Beck's circuit, and it did indeed produce colloidal silver. The only drawback I found was that the "dim glow" of the bulb was a somewhat subjective indication of current, which varied with the conductivity of the water, the condition of the batteries and the length of electrodes immersed in the water. This made it difficult to get repeatable results. What was needed was a circuit with fewer variables.

With this in mind, I designed the circuit shown in **Fig. 1**. The circuit uses a small 24-volt transformer, a bridge rectifier, and two electrolytic capacitors to form a small AC-operated power supply. This supply provides 32 to 35 volts DC to a 7805 regulator, which is connected as a constant-current source. Since Dr. Beck's current indicator was a 40-milliamp bulb lit to half-brilliance, I selected the resistor R1 to provide 20 milliamps, allowing the use of a standard Light-Emitting Diode (LED) as an indication of proper operation.

This is a very simple and non-critical circuit, and could easily be wired point-to-point on a small piece of perfboard. However, to make the circuit as easy to build as possible, a circuit board pattern and parts layout is shown in **Fig. 2**. I mounted the completed circuit in a small

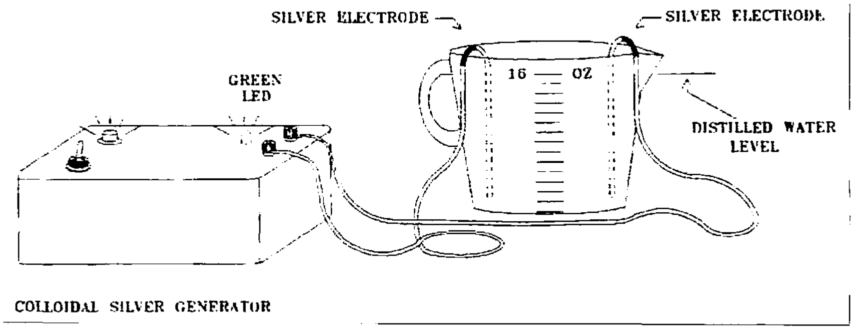


Fig. 3. Making silver colloid is easy: use a glass measuring cup and 16 ounces of distilled water. Let the generator run for 5 to 7 minutes.

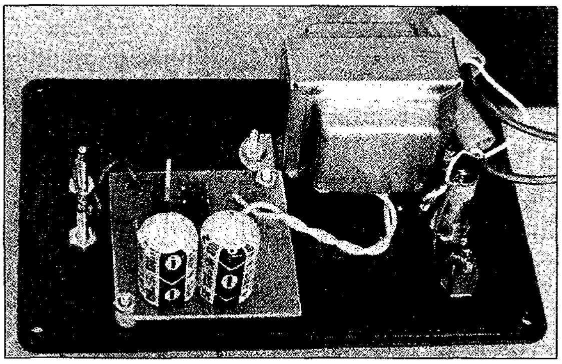


Photo B. Inside the colloidal silver generator. The LED is mounted on the back of the circuit board and extends through the front panel.

plastic project box with the AC switch and pilot lamp on the left side of the panel. I put the LED and a pair of binder posts to connect the electrodes on the right. The completed Colloidal Silver Generator is shown in **Photo A**.

The most critical component of this project is the electrodes. They **MUST** be made of .999 fine silver. **DO NOT** under any circumstances use "sterling" or any other silver alloy, as the metals used can be toxic in even very small amounts.

Cut two pieces of #12 round fine silver wire, each 4 inches long. Solder a 24-inch piece of flexible insulated hookup wire to one end of each electrode. Clean each solder joint with flux solvent and coat the solder with a drop of clear urethane varnish or nail polish. Slip a 1-inch long piece of shrink tubing over each wire and push it down to cover the solder joint. Use a heat gun to shrink the tubing over the connection.

Using needle-nose pliers, bend the upper portion of each electrode, just below the solder joint, in a "U" shape about one-half-inch wide. When the electrodes are hooked over the side of the glass, about three inches of silver wire should extend down into the water. Note that the shrink tubing and solder joint **MUST NOT** be submerged! You do not, after all, want to make "colloidal lead" or "colloidal tin." Strip the ends of the electrode cables and connect them to the Colloidal Silver Generator.

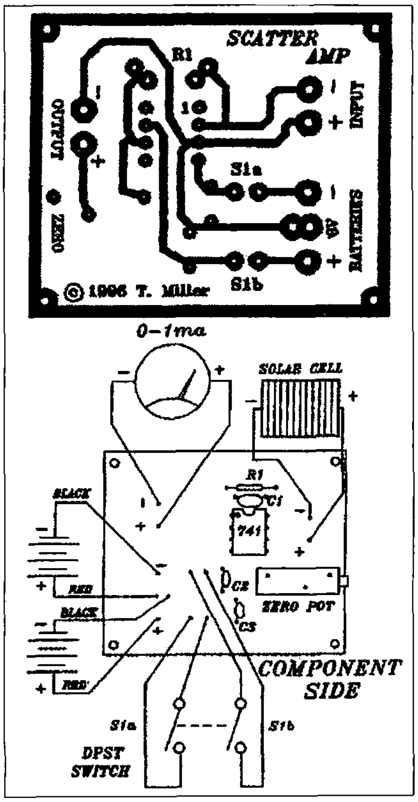


Fig. 5. Circuit board pattern (foil side) and parts layout for the light meter. The solar cell is very fragile, so handle with care.

"Every mineral that exists is dissolved in the sea, and therefore is also present in sea salt."

You will need some distilled water and also some non-iodized salt. Don't use iodized salt, as the iodine could make unwanted chemical compounds. Also, some brands of salt use aluminum silicate as a desiccant, and while it's not likely that this could be harmful in such tiny amounts, I checked the labels until I found one that uses sodium silicate instead of aluminum.

Some people have suggested using "sea salt" as an alternative to table salt. Sea salt is the residue left behind when seawater is evaporated away. Not only iodine, but *every mineral that exists* is dissolved in the sea, and therefore is also present in sea salt. In fact, sea salt is sometimes used in place of table salt as a trace-mineral supplement. Use only pure, plain, non-iodized salt.

Colloidal silver should be made and stored in a glass container. Plastic can hold a static electric charge which will cause the silver particles to collect on the sides. I use a 16-ounce glass measuring

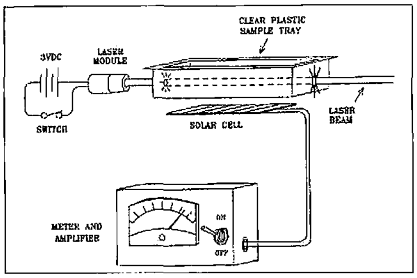


Fig. 6. Method for checking silver concentration. The solar cell comes packaged in a plastic "bubble pack" which makes a perfect sample tray.

cup. Hook an electrode over each side of the rim, and fill the cup with distilled water. The electrodes should extend down into the water, but remember that the solder joint must be above the water line. The proper setup is shown in **Fig. 3**.

When you first turn on the Colloidal Silver Generator, the pilot lamp will glow. The green LED may glow very faintly, or not at all, depending on the conductivity of the water. Add a tiny amount of salt, just a few grains at a time, and stir gently with a plastic spoon. Add just enough to make the green LED glow to normal brightness. If you look closely at the positive electrode, you will see a wispy cloud of silver particles coming off into the water like faint white smoke. After five minutes, turn off the Colloidal Silver Generator, remove the electrodes from the cup, and gently stir the colloidal silver with a plastic spoon. Silver is sensitive to light, so keep the colloidal silver in a dark brown glass bottle and store it in a cool, dark place. Always shake the bottle before using your colloidal silver.

After each use, the electrodes must be polished slightly to remove the oxide and scale. Use a small piece of fine synthetic scouring pad, such as Scotch-Brite™, and gently polish them until they are clean. Avoid over-polishing, since you don't want to wear away the silver.

Testing the concentration

After making a bottle of colloidal silver, I realized that I had no way to determine exactly how much silver was in suspension. Colloids are

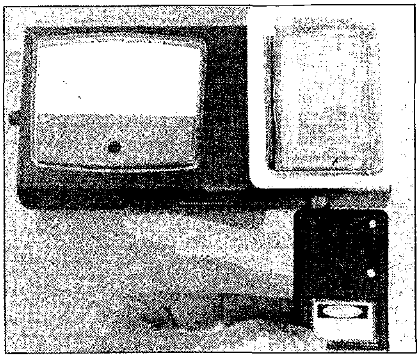


***Photo C.** Since the radius of the silver ion is less than 2 angstroms, far too small to see, silver concentration is checked with a diode laser and a light meter to measure the scattered light. Five to ten parts per million (PPM) is ideal.*

measured in parts per million (ppm), and the concentration of most commercial colloidal silver is in the 5 to 10 ppm range. With a constant current regulator and a measured amount of distilled water, the only remaining variable is time: How long does it take to make a 5 ppm concentration of colloidal silver?

Dr. Beck's article recommended using a small laser pointer to check the silver concentration. These pointers use a laser diode to produce a visible red beam. I ordered a laser diode module and mounted it, along with two 1.5 volt "N" cells and a switch, in a small plastic box.

The laser beam, shining through a sample of distilled water, is invisible when viewed from the side. However, when the laser is directed through colloidal silver, it makes a softly glowing red beam due to the tiny silver particles scattering the light. The intensity of the glow is proportional to the concentration of silver—the more particles there are in suspension, the more photons will be scattered. Simply looking at the glow, however, does not give an accurate measurement. I needed a way to actually measure the scattered light.

RadioShack™ sells a small silicon solar cell (part number 276-124). I bought one of these cells, and *carefully* cut the plastic bubble-pack from the solar cell package—the clear plastic bubble is just the right size to make a small transparent sample tray. I built a small amplifier to drive a meter and attached it to the solar cell. By placing the clear plastic sample tray on top of the solar cell and directing the laser beam through the sample, I could directly measure the scattered light. Of course, the solar cell was also sensitive to normal room light, so my first experiments were done in the dark. I set up the sample and shut off the lights before turning on the amplifier. Later, I made a small cardboard box which I could place over the sample under test.

I first tested a sample of colloidal silver and adjusted the meter zero pot until the meter read full scale. Then I mixed a sample diluted 50% with distilled water—the meter read half scale! A sample of distilled water read nearly zero, with only a tiny amount of reflected light caused by the sides of the sample tray.

This method worked, but it provided only a relative reading. To calibrate it, I filled the sample tray with a commercial 5 ppm colloidal silver purchased at a local health food store. I adjusted the meter zero to read "5" on a 0 -15 scale, then tested a sample which I had made by running the Colloidal Silver Generator for exactly 10 minutes. This sample registered nearly "10" on the meter; double the concentration of the commercial product.

It was clear to me that running the Colloidal Silver Generator in 16 ounces of water for five to seven minutes will produce an ideal concentration of silver. Therefore, if your only interest is in making your own colloid, it's not necessary to build the light meter. I have included the circuit here for those who wish to experiment with the laser backscatter phenomenon.

Fig. 4 shows the schematic diagram of the meter amplifier, while the circuit board pattern and layout is shown in **Fig. 5**. There is nothing critical about the circuit, but note that the solar cell is *extremely* fragile, and you must carefully solder wire leads to each side. Use only small, flexible wire to avoid placing any stress on the solar cell. I used a piece of tiny two-conductor wire from an old earphone. **Fig. 6** shows the method used to measure the laser backscatter.

I would enjoy hearing from readers about their experiences with colloidal silver. The easiest way is via the Internet: My E-mail address is thomil@infocom.com. Also, information on this and many other circuits is available on my Web page. If you have access to the Web, the URL is: http://www.infocom.com/~thomil/.

Letters sent via the U.S. Postal Service will also (eventually) reach me. If you write, please include an SASE.

Further reading:

"Colloidal Silver, What the Pharmaceutical Cartels Don't Want You to Know," *American Survival Guide*, August 1996

"Silver, Our Mightiest Germ Fighter," *Science Digest*, March 1978

"Currently Preferred Silver Colloid Making Apparatus, Means and Methods," Robert C. Beck, August 1995

"A Few Unique Plus Traditional Uses For Silver Colloid," Robert C. Beck, August 1995

Acknowledgments

Thanks to Justus Parrish, metallurgist, author and president of Metallurgical Services of Richmond, Indiana for his insight into testing metallic colloids.

Special kudos to the eminent and somewhat elusive physicist, Robert C. Beck, D.Sc., for his many original ideas and his willingness to share them with experimenters.

Continued on 81

Number 26 on your Feedback card

73 Review

Cable X-Perts' G5RV Multiband Antenna Kit

What to do when you're tired of making do.

Peter A. Bergman NØBLX
3517 Estate Dr. SW
Brainerd MN 56401

After several years of using dipoles strung from trees and whatever, I decided to get more organized and try something different. House wire and lamp cord just weren't doing the job for me.

I thought about just getting some hard-drawn wire and using it to replace my dipoles, but I had worked a number of stations that were using G5RVs and decided to give that a try.

While the G5RV looks like an open-line-fed dipole, it differs in a couple of ways. A conventional dipole is cut to a half-wavelength on the lowest frequency of interest. However, a full-size G5RV is cut to 3/2 waves at 14.15 MHz (102 feet) and uses 34 feet of open line as a matching section. This provides a pretty close match to feedlines with impedances of anything from 50 to 80 ohms, either twinlead or coaxial cable. Since the whole system will be brought to resonance with a tuner anyway, the standing waves on the feedline won't matter too much.

While the 34 feet of ladderline functions as a matching transformer on 20 meters, on the rest of the bands it functions as a "make-up" section to accommodate that portion of the standing wave (voltage and current components) which cannot be handled on the flattop.

Since there are no ferrite beads or traps involved, the G5RV tends to be very efficient. On 80 meters the pattern looks like a typical dipole. On 40 and 30 the pattern is similar to that of two half-waves fed in phase. On 14, 18, 21, 24 and 28 MHz the pattern is that of a long-wire antenna.

The full-sized G5RV can also be used on the 160-meter band by shorting the feedline and bringing the antenna to resonance with a series-connected capacitive-inductive tuner. The tuner, of course, must be connected to a good earth ground or counterpoise wire.

If space is limited, the flattop and matching section can both be shortened by half, which will produce an efficient antenna for seven through 28 MHz. If you want to use the half G5RV on 160 and 80 meters, the above tuner and shorting arrangement will have to be made. In this case the G5RV will perform more like a top-loaded vertical but should still provide good performance.

Since it probably won't be practical to connect the transmitter directly to the matching section, some kind of feedline will be necessary. According to what I've read, almost any line—coax or parallel—with an impedance of 50 to 80 ohms will work. Try to keep the feedline under 70 feet in length. The use of a balun is not recommended.

After thinking about it for a while and checking the junk box—where I found mostly junk—I decided to order the G5RV kit from Cable X-Perts.

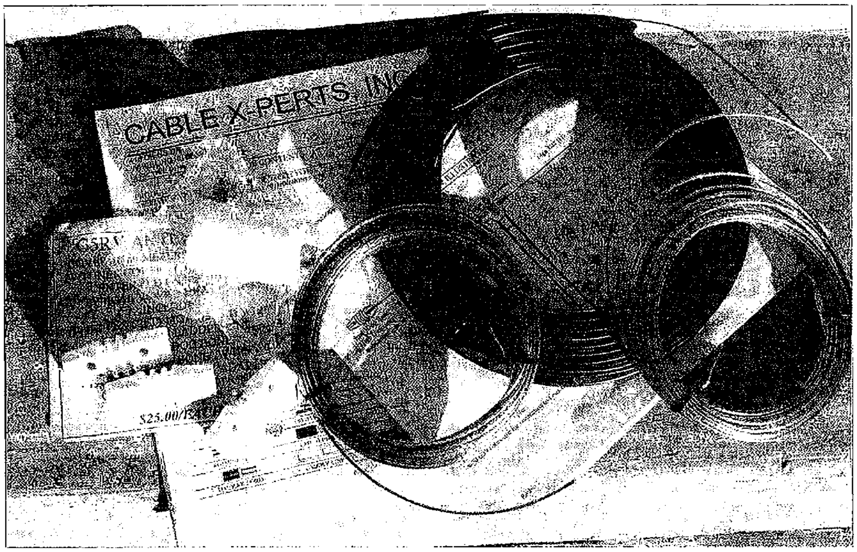


***Photo A.** Cable X-Perts' G5RV multiband antenna kit.*

This is a *kit*?

The hefty box arrived in a very few days, which was gratifying. The contents (**Photo A**) included 104 feet of 14-gauge 7/22 hard-drawn copper wire, 35 feet of 450-ohm ladderline, two end insulators, a center insulator and a 450-ohm ladderline-to-coax adapter. Also included was a detailed set of instructions and a reprint of an article by Louis Varney G5RV himself. The article explains the theory of operation of the antenna and adds some detail on the proper installation.

Calling this a kit is a bit of a stretch, since the whole assembly job can be done on the kitchen table in just a few minutes. There are only four solder connections to make, but you will definitely want to use a gun for this job. Especially

on jobs where a lot of material is involved, I prefer to do my soldering indoors or at least out of the wind. It can be difficult enough to get a joint hot enough for the solder to flow properly when you have 85 feet of copper wire sucking heat away without having the wind cooling it, too. I have even been known to drag the end of an antenna into the car just to get out of the wind.

Installing the antenna should be pretty straightforward. Make sure you unroll the wire and the ladderline. Don't just pull it off the roll sideways like line coming off a spinning reel. If you unroll it there will be less risk of getting kinks in it and the wire should hang straighter.

The G5RV can be installed as an inverted vee, but the angle is supposed to exceed 120 degrees. It's best to think of it as a flattop. The ladderline should hang in the clear as much as possible, and at least the top twenty feet of it should hang vertically. Naturally, it's best if the antenna is mounted high enough that the entire matching section is vertical and the connection to the feedline is suspended above the snow (in my case it requires a center support about 40 feet high—so much for global warming).

How does it work?

Some users who have been able to hang the antenna above 35 feet with the matching section in the clear have reported VSWRs of two or less throughout most of the HF ham bands. My situation is not nearly so ideal, but it requires very little tweaking with the tuner to achieve unity SWR anyplace I want it.

I sometimes work QRP and never use more than 80 or 90 watts; as far as efficiency is concerned, the G5RV is a vast improvement over what I'd been using. I am getting closer to the ideal of "hear them and work them."

Whether you're an old hand at all this, or a newcomer looking for your first HF antenna, give the G5RV some consideration. Or, if you have some other antenna design in mind and are looking for quality materials, take a look at the Cable X-Perts catalog. I think you'll be pleased. For further information, contact Cable X-Perts, 416 Diens Dr., Wheeling IL 60090; to order ($25 plus $6.50 s&h) call (800) 828-3340; for technical information call (847) 520-3003; FAX (847) 520-3444.

Number 27 on your Feedback card

An 8088 Clock Upgrade

Recycle!

Lisa Davis
2830 W. Kent Drive
Chandler AZ 85224

Evert Fruitman W7RXV
2808 West Rancho Drive
Phoenix AZ 85017-2646

You would probably be hard pressed to find a man-made computer older than the abacus. The masters of this somewhat primitive machine could do calculations with great dexterity and surprising speed. Today, you are more likely to find one in a curio shop than in a business or a scientific laboratory.

Once the early computer developers got past the beads and wires of the abacus, they tried many different things for the switching and the storage elements. Relays, vacuum tubes, and transistors all served the purpose. Eventually, engineers combined many transistors into one package, making the now common integrated circuit. This gave a saving in space, a notable increase in speed and a monumental increase in complexity.

At first, those who had to do many complex computations found the accuracy of these mechanical computers somewhat of a delight. But when programmers found that the machine could do calculations much faster than people, as well as more accurately (most of the time), speed soon became the primary goal.

Just a short time ago, a dual-speed 4/6 MHz system was considered state of the art.

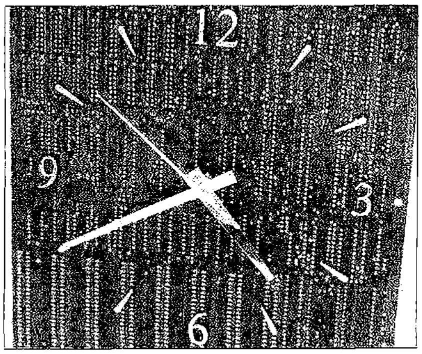


Photo A. *Front view of the 8088 clock.*

Now a system that runs slower than 100 MHz seems outdated. As the 8088 gave way to the faster 80286, and the '286 gave way to the '386 to the '486 and finally (for now, that is) the Pentium™, the older processor boards found their way to the scrap heap more and more frequently. Here is a modification for one of those old boards that could put it back on your desktop, or even on your wall.

The modification

As the photo shows, this modification uses an external clock. However, do not panic—you can find this critical component at a hobby/craft store. Although the original plans call for an 8088 motherboard, any other board about the same size will give equally pleasing results. Simply look for a clock suited to the dimensions of your particular board. While at the store, you may want to consider the possibility of framing your finished system. It should take less than an hour to make the improvements to the 8088 board.

Start the modification by locating the center of the board. With a small electric drill and a high-speed bit, drill the mounting hole indicated in the instructions that come with the clock. Next, mount the clock, attach the hands and the numbers, then install the battery and set the clock to the correct time of day. Finally, locate a suitable spot on your desk or wall and set it in its newfound place of honor. This simple, relatively inexpensive modification gets some of those old boards out of the scrap pile by making an upgraded 8088 board into a system suitable for use on your desk or wall. In our case, the clock made a nice gift for someone who works with computer hardware and software all day and found the clock a delightful addition to his office wall.

Number 28 on your Feedback card

The California Phased Array

Easy to build, easy to use—and even easier on the billfold!

Dave Evison W7DE
153 Park Avenue
Palo Alto CA 94306

If you're interested in a compact, small-footprint wire antenna for 20 meters that has an honest 3 dB gain, is electronically rotatable, requires no tuner, and can be built for less than $25, read on—because that describes the California Phased Array.

The design constraints for the original California Phased Array were my very thin billfold, small city lot, TenTec Scout (50W), and a couple of palm trees. Since the palm trees are about 50 feet tall and spaced about 40 feet apart, I figured I had a couple of environmentally-correct towers. The immediate response was to simply stretch a dipole between my "organic supports." This I did, and though it worked admirably, I pined for something with gain and directivity. The technical requirements began to form in my mind: No radials, feedpoint at least 1/4 wave off the ground, and gain of 3 dB. From these points, the California Phased Array was conjured.

Say "abracadabra"

The antenna is actually a pair of half-wave wire dipoles, vertically oriented, and fed in phase or 180° out of phase—hence a two-element broadside or endfire array (and a "California" Phased Array because of the palm trees). Using half-wave dipoles eliminated the need for a radial system, ensured the smallest possible footprint, and elevated the feedpoints greater than 1/4 wave above earth ground (see **Fig. 1**).

The dimensions for the dipoles and phasing lines were calculated from the standard antenna formulas at 14.2 MHz, and they are specified in **Fig. 2**. Although the original California Phased

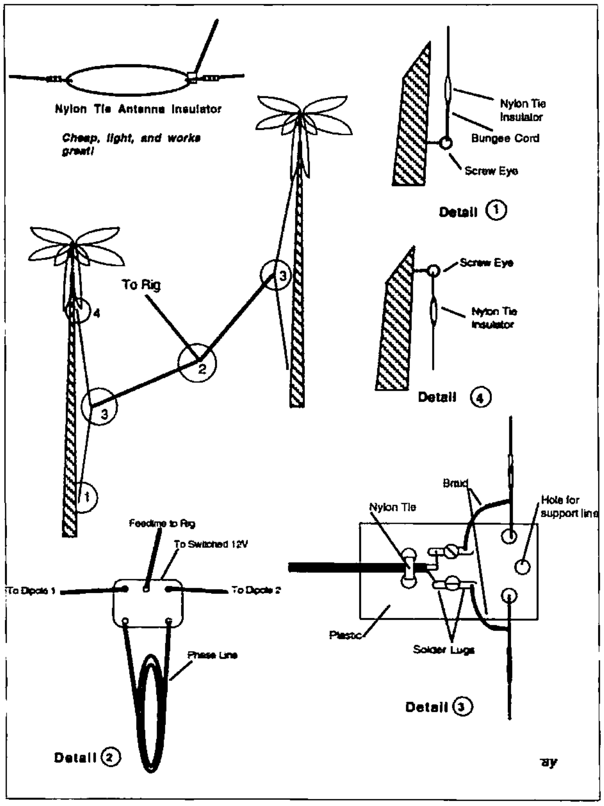


Fig. 1. See why it's a "California" phased array?

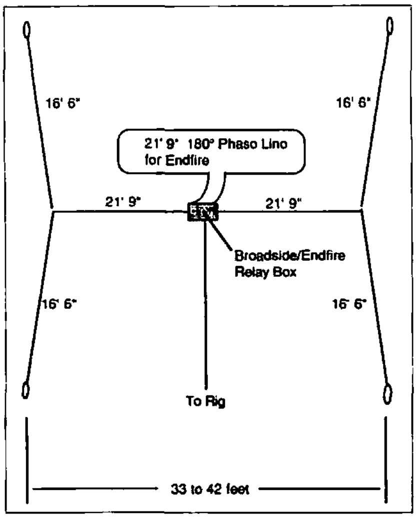


Fig. 2. Dimensions of W7DE's setup.

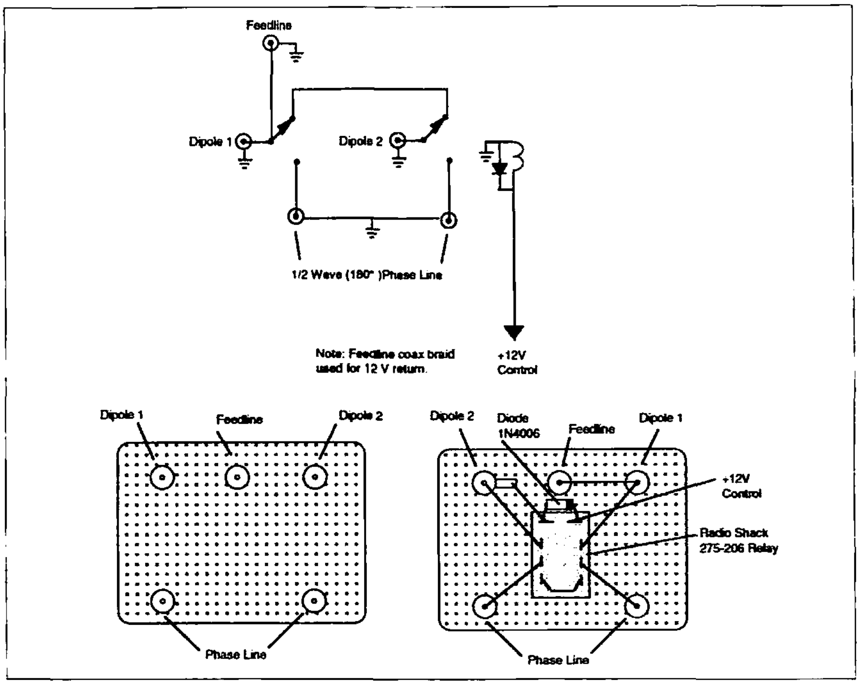


Fig. 4. Remote control box for electronic rotation.

Array was designed around the palm trees as supports, and the dipoles are separated by approximately 40 feet, other available supports and spacings can be utilized (H-plane patterns for the California Phased Array, depending upon your final spacing, can be found in *The ARRL Antenna Book*). Some alternate physical configurations are illustrated in **Fig. 3**.

Details for the relay assembly that switches the additional half-wave phasing line in and out (to rotate the array electronically) are shown in **Fig. 4**. The relay and BNC connectors were assembled in a small metal enclosure. The shield of the coax feedline is used for the DC return when energizing the relay coil.

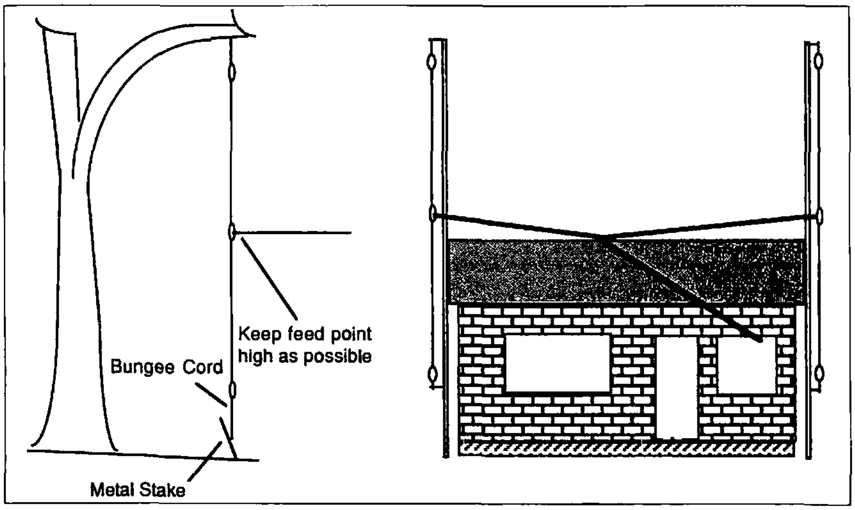


Fig. 3. Alternate configurations.

The initial checkout of the antenna was performed on the broadside configuration. I measured each dipole individually and found it to be flat across the band and about 47 ohms. When I connected the phasing lines of the antennas together, I fully expected to see something around a 2:1 SWR (about 23 ohms); instead, I found virtually no SWR and 47 ohms across the entire 20-meter band. I even changed the battery in the little MFJ SWR analyzer, and still got the same measurements. Here's why: If an array of two identical elements is fed in phase or 180° out of phase, both elements have the same feedpoint impedance. With these arrays, feeding the elements through equal lengths of feedline (in phase) or lengths differing by 180°

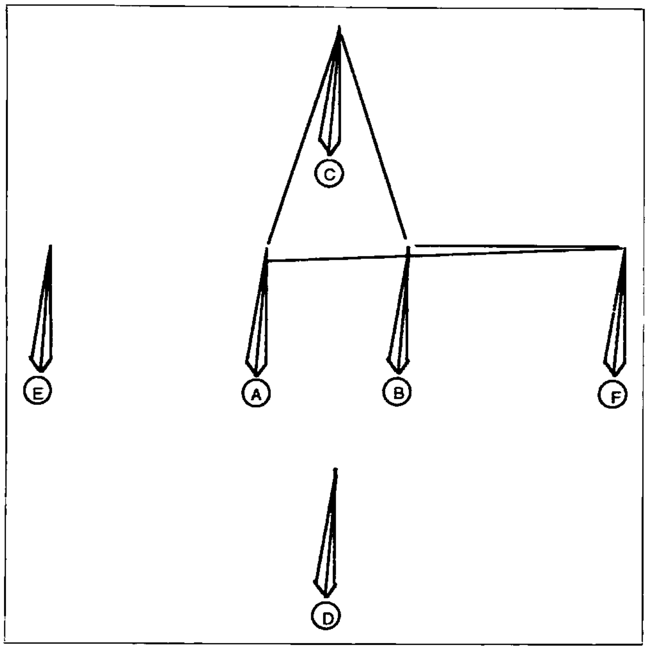


Fig. 5. Gain and directivity.

the signal from one transmitting antenna is farther away by one half-wavelength and it will arrive at the receiving antenna 180° later than the closer one. This will put the signals back in phase and the signals will add.

(out of phase) will lead to the correct current and phase match, regardless of the what the line length is.

The California Phased Array can deliver an honest 3 dB gain, and here's a simple explanation of how it does (see **Fig. 5**).

•Broadside (in phase) phasing: Antennas (A) and (B) are identical vertical dipoles separated by one half-wavelength and fed in phase. Receiving stations (C) and (D) are equally distant from antennas (A) and (B). The signals from (A) and (B) will, therefore, reach antennas (C) and (D) at the same time, in phase, and will add. However, receiving stations (E) and (F) will receive the radiated signals from antennas (A) and (B) 180° out of phase because the signal from the transmitting antenna that is farther away by one half-wavelength will arrive at the receiving antenna 180° out of phase, subtract and cancel out.

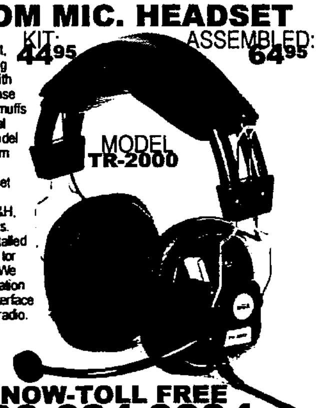
•Endfire (180° out of phase) phasing: The antennas are the same as above, but this time antennas (A) and (B) are fed 180° out of phase. In this case, since receiving stations (C) and (D) are equally distant from antennas (A) and (B), the signals will reach antennas (C) and (D) at the same time, but since the radiated signals are 180° out of phase, they will subtract and cancel out. However, in the case of receiving stations (E) and (F),

It's so simple

There you have it: Gain and directivity with a simple wire antenna system—and all you need to rotate it electronically is a simple relay to switch an additional phasing line in and out.

The only thing critical about this antenna system is to be as precise as possible when preparing the dipoles and the feedlines. If a metal tower is used for support, the proximity of the tower will affect the characteristics of the dipole and distort the radiation pattern to some degree, but who knows? It may even improve performance. The original California Phased Array used RG-58U, because it's light and I never run over 100 watts. For high power usage RG-8 must be used.

Upon completion of the antenna system, I conducted its maiden test. While running 50 watts SSB, within a 35-minute period (I did a little rag-chewing) my first contacts included W1AW (CT) and KH6/W7GMH in Hawaii. This certainly demonstrated that the two major lobes were doing what they were supposed to do in the broadside configuration. A second test (also in the broadside configuration) was performed during the California QSO Contest (5 October 1996) and within an hour and a half, I worked 12 states and Canada (once again, 50 watts SSB). On-the-air testing is still underway in the endfire configuration (which is north and south from my San Francisco-area QTH). I'm sure hearing a lot of Spanish-speaking stations, so I guess I'll have to brush up on my Spanish!



Kindergarten, a Two-Wheeler, and a Ham License

It's fun, and very handy, to have more than one amateur radio operator in the family.

Peter A. Bergman NØBLX and
Chandra E. Bergman KBØYXB
3517 Estate Dr. SW
Brainerd MN 56401

My middle daughter Chandra, a/k/a "Shorty," has been wanting to be able to talk to me on the radio since she was two years old. Around Christmas 1995, after her sixth birthday, she said that she wanted to get her radio license so she could talk on the radio. That was an entirely different matter. She had been along and helped a bit during various public service activities, so she knew there is more to ham radio than being able to talk to people while they drive around. She had also expressed an interest in HF QRP. "Work the world on a watt," she says.

For those of you who are new to all this, getting an amateur radio license does require that the applicant pass some tests. Each of the six license levels carries with it a different level of privileges. At this time the no-code Technician license seems to be the entry point of choice to ham radio.

The Federal Communications Commission sets the standards and specifies what must be covered in the various tests. Fortunately, the FCC publishes a pool of test questions and answers from which the actual tests must be compiled, so there is no doubt about what must be studied for each class of license. Study guides containing the complete pool for the desired class are available from several sources.

I told Chandra that I would have to order a special book for her to study and that she would have to study every day. Then I waited a few days and she asked again, and again a few days after that. At that point it seemed she was still serious so I ordered Artsci's *Riding the Airwaves with Alpha and Zulu*. I chose that particular study guide because about half of the book is cartoons and illustrations which I hoped would help hold a young person's interest.

At least once a day I heard, "Dad, is the special book here yet?" Fortunately, the book arrived on January 9th, less than a week after it was ordered.

Since a completion certificate is provided for those elements passed at each test session and since the certificate is good for a full year, we decided on a simple strategy. We tackled one element at a time. There are tales of people walking in off the street and walking out with General class license, but I thought that would be a bit much for a six-year-old.

Chandra did pretty well in her studies. Sometimes it was hard to "stay on task" but we managed to have a study session almost every day, usually between supper and bedtime when we would normally have story time. Sometimes we had story time, too. Despite the fact that Chandra was only in kindergarten there were many, many distractions. One day she brought home the "Teddy" bag from school. Teddy had to be clothed appropriately, fed at regular times and a log book kept so she could tell the class how Teddy's visit to our home went. Teddy joined us for our study session that night.

I asked Shorty once if she had tried telling her schoolmates about ham radio and her studies. She said that she had but, "Dad, it takes an *hour* to explain it!"

Our original target date for her first test was the Fergus Falls hamfest on April 20th. But when she heard that I was going to the Fargo (North Dakota) hamfest on March 9th, she wanted to go along so she could try the test. Fortunately we had a friend along who could be the reader (responsible adult) with her in the test room. I did not want to be there because I was too deeply involved and I had a booth at the hamfest. I was afraid that I'd get both of us

Photo A. Chandra Bergman KBØYXB, age 6, passed her Novice written test—and *learned to ride a two-wheeler.*

thrown out by prompting her. Besides, the VEs wouldn't let me.

During the test I was as nervous as a long-tailed cat in a room full of rocking chairs—but somehow I managed to keep my mind more or less on the booth.

No, she didn't make it. She got 20/30 and needed 22/30 to pass. But she came out of the experience determined to do better at Fergus Falls. Some of the things Dad had insisted she'd have to know actually showed up on the test. She got more serious at study time. Well, sort of. To help her with some of the facts she had to learn—like frequency assignments—we made little signs which we hung in various places around the house—the refrigerator door was our favorite spot.

The weeks between the Fargo hamfest on March 9th and the Fergus Falls (Minnesota) hamfest on April 20th seemed to go by awfully fast. All of a sudden it was 4:00 am, April 20th. We were on our way to Fergus Falls. I thought about going over

some of the questions while I drove in the dark. Or getting Joe NØUME, our handi-ham buddy, to drill her a bit. Chandra had other plans—she went to sleep. We arrived early enough that we were able to join some friends for breakfast.

During breakfast I did ask some questions, both of Shorty and her friend Mike, who was also testing. She seemed to have her facts straight and rattled off answers between bites of food. One of the restaurant's other patrons that morning happened to be one of the Volunteer Examiners. He came over to visit with us for a few minutes and announced that a separate room would be set up for the kids so the reader and the kids wriggling wouldn't unnerve any of the other candidates.

Shorty was cool. We arrived at the fairgrounds, got the car unloaded, got Joe out of the car and into his chair and set up the booth. Chandra displayed her usual *joie de vivre,* both helping me and running all over the place with her friends.

Sharon KBØSQX, Shorty's reader, and her husband Jim KBØTXT arrived well before test time. Chandra had never met them but took an instant liking to them and seemed very relaxed with Sharon. Finally, they went in to test and after what seemed like a long, long time, they came back out with my daughter, as always, hyperactivating all over the place. An eon later we learned that she had passed the Novice written test with a respectable score. Everyone was pleased.

At this point, although we had not really spent any time on the Technician portion of the book, I asked her if she wanted to try the test anyway. Yes. They headed back to the testing area and I went back to trying to work my booth. Sometime later someone came out and told me that she had passed her test—I was thinking that not only would she want that new hand-held, but she'd probably want to drive home. Oops. Yes, she passed a test—the Novice written—Element 2. She got a 12/25 on the Technician written—Element 3A. Actually that wasn't bad, considering we had only flipped through that part of the book.

The Duluth/Superior hamfest loomed ahead. I had to get my booth supplies reorganized, and more study-time had to be spent—on evenings when the lengthening twilight called louder and louder to both of us. Friends to play with, bushes to plant, fish that needed catching, antenna projects, a two-wheeler to learn to ride. Nuts! Just two weeks between hamfests and testing sessions.

No, she didn't quite make it that time, either, but she just wouldn't quit despite a number of events—including a house fire—that would have discouraged a lot of people.

Finally, on the 4th of November, 1996, Chandra passed Element 3A and received her certificate. A few days later we learned that she had received callsign KBØYXB, and a few days after that she actually received her license in the mail—surely a big improvement over the long wait many of us have experienced in the past.

As I became more sanguine about Shorty's prospects I realized I would have to produce at least a two-meter rig that she could use. She was so confident of my ability to provide something that all her pop-can money had already been earmarked for a new bicycle. So I dusted off an old crystal-controlled rig that had been at the back of the shelf for a few years. After replacing one crystal, cleaning, and realigning, it looks like it should give her good service. By the time this article is in the mail she should be set up with the old rig, a borrowed power supply, and a flexi-j antenna at her mother's house.

In the meantime she has already used it in a minor emergency. The phones went out while she and her baby sister were here so she was able to call me while I was driving around at my day job. She relayed the correct phone numbers to me and I was able to make the call to get the phone repaired.

So what does it take to get a new ham in the family? An interested student, a willing teacher, a time and a place to study, and appropriate materials.

Was all the effort worthwhile? We think so. And it sure is handy to have another ham in the family. She is starting to talk about Element 1A—the code. When she passes that I guess it will be time for Dad to check the back of the shelf for an HF rig!

A note from Chandra KBØYXB: If you want to do good, you have got to study hard every day. If you do not pass a test, you have got to study more 'til you can pass the next time. It is like learning to ride a bike—you have to keep doing it 'til you do not need your training wheels anymore. 73s.

Riding The Airwaves with Alpha and Zulu is available from Artsci, Inc., PO Box 1428, Burbank CA 91507. Phone (818) 843-4080 or FAX (818) 846-2298.

Mini-Grid DXpedition to FM13

Sand, sun, & almost too much surf!

Robert "Greg" Robinson KB4NVD
208 Dogwood Acres
Hampton TN 37658

I had been wanting to go somewhere special to operate for a long time, and on the weekend of August 12, 1995, it finally happened. Mike N4OFA and I had been very busy at work and weren't sure that we would actually be able to go until the afternoon of the day before—but we were at last able to make it down to FM13 for a weekend of operating and sunshine. Why FM13? Well, this is a rather rare grid square to work because 95% of it is out on the water and the remaining 5% is loaded with mosquitoes!

We drove down to North Carolina Friday afternoon and found the closest campsite was about two miles into FM14. After ten hours of driving from east Tennessee we figured that was close enough. Mike was too keyed up to sleep after setting up the camper, so we drove on down to FM13 to scout the area for potential operating sites. We found a parking area at Fort Fisher State Recreation Area that looked good and gave it a try. There was a meteor shower that weekend, and we thought there would be more operators on, but after many unsuccessful CQs on 144.200 we gave up. We did see some pretty good shooting stars, though, before we headed back to the campground for some rest.

Saturday morning found us roasting inside the pop-up camper with the temperature in the high 90s and humidity to match, but we set up in time for the afternoon passes of RS-10. We found the parking lot packed full (not deserted like it was after midnight) and decided to operate right on the beach (there is four-wheel-drive access). "Hey Mike," I said. "This is why I really brought the Bronco!" Mike was a little skeptical but was willing to go along with it. We made it out a ways but got caught in one of the softer areas behind the dunes. We were almost too late for the first pass of RS-10, so we set up for it right on the spot. That pass netted three Qs.

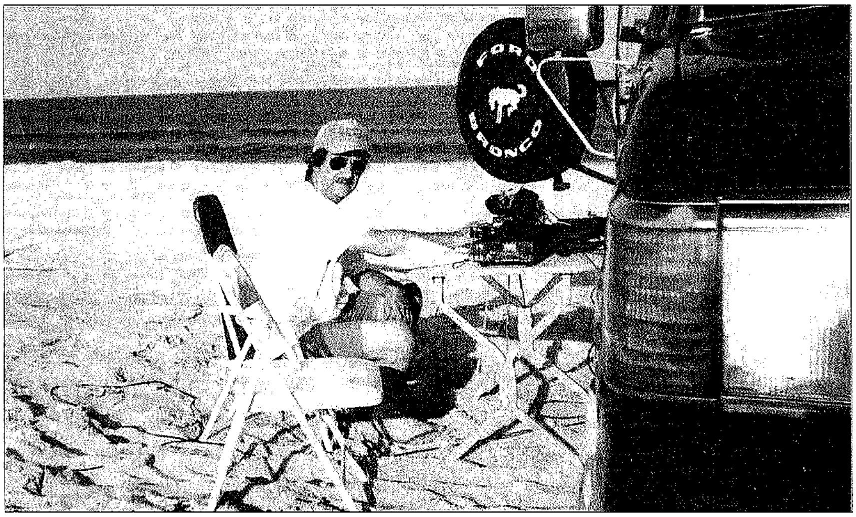


Photo A. N4OFA on 2m CW.

After the pass, we relocated about 15 yards away, right over the dune next to the beach. I lowered the air pressure in the tires to give them a better footprint in the sand and drove around to the beach access. The dunes are very fragile and prone to erosion; no driving on them is permitted. Special crossovers are marked for access out onto the beach. Mike carried the 10m turnstile over and picked out a great spot. We set up all the equipment and took a swim to cool off—the heat index was over 110 degrees. We got out of the water in time for the next pass of RS-10 and worked four stations this time.

We got so caught up in operating that we stayed until 11 p.m., but were finally driven off the beach by hunger and thirst (I was drinking melted ice from the cooler and Mike actually ate part of an MRE I had brought). We made a fair number of Qs to the north, up into FM19

and such. To the east we completed a schedule with Carl AA4H (EM86) back home in east Tennessee. He had wanted to come along but decided he would rather work us while we were down there. Nothing was heard to the south.

Sunday, the heat index went over 115. We took the *big* cooler with us this time, and all the food. We called CQ for a long time before we had any takers, but once we'd worked a few, the word we were on spread quickly. We had a great opening into Florida as the evening wore on, and worked 29 stations.

Murphy strikes again

EL98 seemed to be the center of the other end of the opening. After a long run of stations I finally had to have a break. Mike was going to do his CW magic and I was going to drink a gallon or two of water. I went around to the back of the truck where the cooler was and found the sand firm and moist. Hmm, this isn't right. Did Mike spill the cooler and not tell me? I went and got a flashlight, and holy cow! A wave had washed all the way up to and around the cooler. There was sea foam about ten feet from the truck. Murphy was here—using the name of Hurricane Felix. High tide was in and with the boost from the hurricane the waves were going to come up a *lot* higher than on the previous night. Right around the truck, it looked like.

I had visions of what the XYL was going to say: "You lost the Bronco but saved the *logs*?" Mike and I broke the station down in no time flat and were set to abandon the antenna. We moved the truck up away from the water and watched to see just how the waves were going. We decided that it would be OK to take the time to get the antenna and then get out of there. Mike walked ahead checking the progress of the water while I followed in the truck.

There was just a narrow strip left to drive on. When I got near the crossover I hit the horn and blasted off the beach without letting off the gas. Mike got out of the way pretty quick and caught up with me on the other side of the beach access. This was not a time to get stuck!

Mike and I had a great time operating from a rare grid and want to go back. We have identified some things to improve on, such as more power on 6m, and more bands. Also, the 10m rig had some problems that kept us from being effective on mode A. Being able to use headphones and control the volume (which was stuck wide open) would have been great.

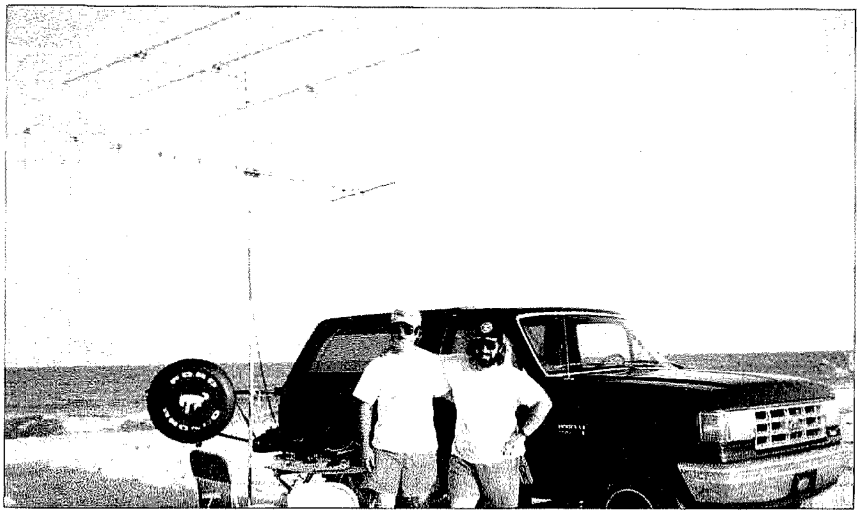


Photo C. *Mike N4OFA and Greg KB4NVD, portable in grid FM13.*

We may not have worked all that many stations, but the ones we did seemed pretty happy. For those in Florida who were wondering why we went off the air so abruptly, now you know why. The farthest station worked on 2m was Jordan WB2QLP in EL96, 538 miles away.

Many thanks to those who helped with equipment and spotting us on the various DX clusters.

The stats

Location: Grid FM13, Fort Fisher State Recreation Area, North Carolina

Operators: Mike N4OFA, Greg KB4NVD

Bands: 6m, 2m and mode A satellite

Equipment: Ten-Tec Scout w/ Ten-Tec 6m transverter; 3-el beam; Kenwood TR-751A; Mirage 160W brick; 10-el beam & Larsen 5/8-wave 2m mobile (uplink antenna for RS-10); HTX-100 10m (for mode A rx); turnstile

Pulling them in

•On 2 meters we worked 47 stations in grids EL88, 96, 97, 98, and 99; EM86, 90, 93 and 94; FM03, 05, 07, 08, 14, 15, 18 and 19.

•On 6 meters we worked 4 stations in grids EM94; FM03, 05.

•We worked 7 stations through the RS-10 satellite, and 2 stations through the RS-15 satellite.

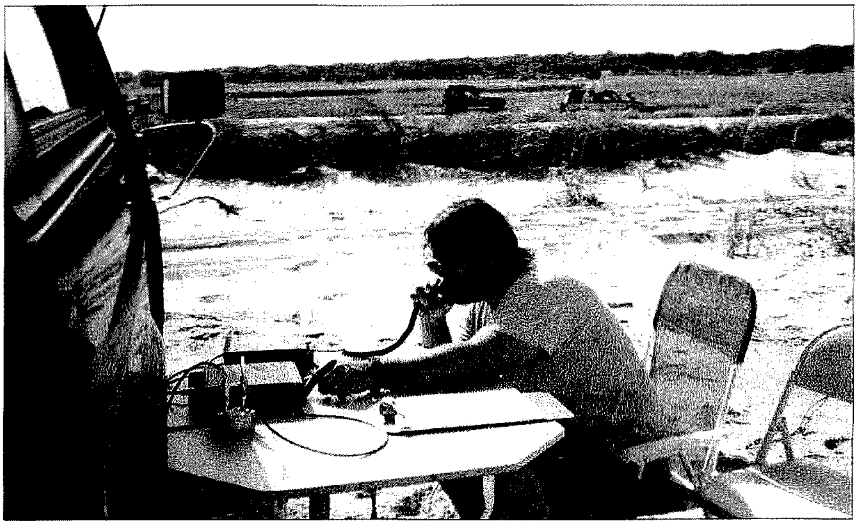


Photo B. *KB4NVD on RS-10.*

Reprinted from The Satellite Operator, *December 1995.*

Limit Morse Code Testing to 5 Wpm

For any class of amateur radio license.

Guy A. Matzinger KB7PNQ
503 Dubois Street
Cheney WA 99004-1325
E-mail: guym@on-ramp.ior.com

Amateur radio is constantly referred to as a *hobby*, but it has regulations that are more severe than some professional organizations require for association. Why does a spare-time activity, pursued for pleasure or relaxation, insist that high-speed code proficiency must be demonstrated before a license is issued to use other modes and all the amateur spectrum? I believe these code requirements, with their subsequent marginalizing effect, are crippling the hobby.

The FCC acknowledges, in Form 610 (back page) "Notice to Physician," that five wpm is all that is required to meet International Regulations, but that the FCC supports 13 and 20 wpm code tests because the amateur radio service "strongly desires to preserve communications by telegraphy." How do high-speed code tests "preserve" CW? No one is advocating eliminating Morse code from amateur radio—and there is nothing in Part 97 that stipulates you must operate CW at any *standard* speed ... I wonder if I can convince the State Patrol I'm speeding in order to "preserve" my car?

While telegraphy may have been the dominant form of communication sixty years ago, today's interactive electronics have created a fundamental shift in the abilities and desires of amateur operators. Any organization that fails to recognize these changes, and dismisses or diminishes the technical advancements that are evolving around the world, is either naive or blind to mainstream concerns. Amateur radio must face the reality of tomorrow's technology, and the need to change or risk losing participation in the future.

The solution is politics and Congressional legislation. My goal is to collect 5,000 or more signatures of support for a petition to eliminate Morse code testing for *any* class of amateur radio license—or limit such tests to not more than 5 wpm. In order to obtain a fair hearing on this subject, I will personally take the petition before the Telecommunications Commission in Washington DC. In the meantime, I will continue to solicit the support of other legislators for this cause.

> ***"I wonder if I can convince the State Patrol I'm speeding in order to 'preserve' my car?"***

Radio spectrum is generally defined as the range of electromagnetic frequencies between three kilohertz and 300 gigahertz—and today is considered one of the nation's most valuable economic resources. The federal government determines the general uses for the radio spectrum, allocates bands of frequencies and then assigns licenses to specific users. However, this regulatory system has lent itself to abuse by special interests with the American public as the perennial loser. The case for reforming this failed regime is compelling, but it will take political action in Congress (or even the courts) to replace existing regulations. Most FCC processes are prone to delay—a result of good old-fashioned bureaucratic practices—and any attempt to correct this systemic problem is meet with further procrastination, equivocation and seemingly endless delay or even silence.

In 1927, Congress was persuaded to establish a "public interest" communications licensing scheme and in 1934 the Public Interest Standard was initiated so government would have a legal basis for controlling all licensing activities. The Public Interest Standard allowed regulators to engage in both industrial policy and political favoritism. Even today, the FCC does not have a definition for "public interest" and the "standard" (still in effect over 60 years later) is exactly whatever three of the five FCC members say it is. Nothing is ruled out.

The present amateur radio licensing structure is grounded on government-sanctioned policies designed to suppress participation. Complainants have continually criticized the inefficiencies and fundamental unfairness of such a system and with almost 90 percent of the US amateur radio community denied access to *all* of the amateur bands, efficient use of technological advancement is seriously impaired.

It is helpful to recall that in 1934 the telegraph was still the dominant form of communication and in the midst of the Great Depression, many amateur radio operators constructed their own equipment. The analog technologies of the day dictated the form and function of communications. Today, digital

technique known as Code Division Multiple Access (CDMA) presents a massive wideband increase in efficient use of spectrum. Other compression techniques in spectrum management have opened up huge new segments of spectrum and the old approach of the government husbanding scarce spectrum and tightly regulating its use no longer has a valid basis.

The obsolete 1934 Act does not offer the flexibility or provisions to address the innovations and technical changes that are transforming social development globally. For over 60 years, the government's bureaucratic decision-making has been based on the assumption that communications technology would remain essentially static—an assumption untenable for the 21st century.

Whether today's technology becomes a dream of deliverance or a nightmare of disappointment often depends on what you expect. The information superhighway isn't a highway at all. It's a medium we're all in, all the time, and it gives us powers of information and communication we haven't begun to harness. Today's computer hardware and software tools give us the freedom and the ability to reach anyone or anything from anywhere at anytime. They will change the world in ways we can't imagine. And that's a good thing, even if those pickle-headed politicians, bureaucrats and some amateur radio organizations don't get it.

The "Infobahn" is taking to the airways as a host of wireless technologies mature. Utilizing the newest computer tool, live voice audio-conferencing over the Internet is now possible. The software cost is less than $100 and with a SLIP/PPP account, hourly on-line costs are less than three cents per hour (based on $20/mo and 8,760 hrs/yr) to anywhere in the world, anytime, day or night. A fiber in the fiber-optic network can simultaneously carry 37,500 separate conversations. The marginal cost of transmitting a call is literally zero. With these facts and considering the rapid removal of the sight barrier, how are you going to entice the younger generation into amateur radio in sufficient numbers to ensure the future of the hobby?

The truth is, you will never interest enough young people for this hobby to grow unless the Morse code requirement is either eliminated or limited to not more than 5 wpm for any class of license. Why should they be interested in an obsolete method of communicating when the technologies of the future challenge them? Presently, less than 5% of the total US amateur radio population is under 21 years of age. Unless this hobby is made more inviting to the youth of this country, the young will stay away.

A few years ago the IARU (International Amateur Radio Union) formed a CW Ad Hoc Committee to study the feasibility of maintaining or deleting RR2735, better known as the International Morse Code Regulation, which does not have a particular phraseology demand or definitive speed stipulation. The three members of the committee were from Great Britain, New Zealand and the US. The US representative was American Radio Relay League Exec. VP David Sumner K1ZZ. The results of their report were predictable—do nothing.

Apart from the question of whether the emotional ambiguities add up, there is something fallacious about this study. Is it the inclusion of a reference to the 1979 World Administrative Radio Conference (WARC-79) where the ARRL contended that its membership overwhelmingly requested "no change" to RR2735? Is this the reference (now more than 16 years old) constantly used by the FCC to reject all petitions that address Morse code testing practices? Or is it the admission, on page 17, that: "Standards will fall and the result could be congestion by technical-elite operators incapable of self-controlling their occupancy to achieve the best communicating results"—however, again, the "Standards" are never defined.

The statement on page 9 seems contradictory: "Yet it would be inappropriate to require, in an avocation (the dictionary defines avocation as a hobby) that all operators be capable of speaking and understanding a common spoken language"—yet they demand that everyone learn Morse code. Isn't communicating, regardless of method, speaking to others? Interesting admission on page 7: "With limited exceptions, radio amateurs today do not use Morse code to get important messages through under adverse conditions." They go on to say: "It must be remembered that many, if not most amateurs, use more than one

mode." Then why is a single mode with test speeds in excess of 5 wpm imposed on US amateurs? Doesn't this selectively limit participation?

New Zealand, with the support of Great Britain and others, proposed at WRC95 elimination of RR2735. The ARRL opposed the move and claims the US position was "in alignment" with their views.

Several years ago, the ARRL effectively lobbied and was primarily responsible for creating the present amateur licensing structure. It did so with but one thought in mind—self-serving exclusivity. This is the classic case of the minority controlling the majority with bureaucratic help. Keep in mind that the membership portion of US licensed amateurs in the ARRL organization is estimated to be *less than* 25% of the total US amateur community. Hardly majority representation of licensed amateurs.

Factoid: As of March 1995 the total ARRL membership is acknowledged at 172,752. Subtracting those who are not US licensed operators, the league's claim that they represent the majority of amateurs is estimated to fall 2 to 3 percentage points below 25% of the total number of 700,000+ US amateurs.

It appears to me that the chief concern of the ARRL board of directors should be how to extricate themselves from an egotistical blunder initiated several years ago by those in their organization whose sole purpose was to create an exclusive club and selectively limit participation in the hobby of amateur radio.

It's a shame the ARRL doesn't understand that their oppressive incentivized licensing policy and the torture associated with code testing is the major reason their own growth is limited. Their attitude reminds me of the Swiss watchmakers who, having invented the quartz watch, failed to pursue the technology—they went from 46% to 10% of the world market. In this technologically changing world, recognizing the need to change is essential for any organization that wishes to avoid obsolescence.

Nothing mandates that amateur radio operators, using CW, send code at a specified "standard" speed. Why then are 13 and 20 wpm code tests jammed down our throats? Code testing requirements are blunt powers that enable a minority organization to coerce the majority. It is estimated that less than 10% of the amateur community use manual telegraphy on any regular basis.

"The 'standard' is exactly whatever three of the five FCC members say it is."

Why are *all* petitions that propose any change to the Morse code testing syllabus rejected by the FCC? They continually trot out the same tired war-horse with the overused rationale that code requirements were developed with the desires of the amateur community—the who, when and why this occurred is never answered. Is this just a curious irrational coincidence or an intentional cabal—or are those who review petitions without a sense of moral responsibility?

Enough is enough of these politically generated self-serving policies. We need commonsense regulations, not government pandering to organizations who lack consideration for the opinions and rights of others. Maybe it's time these "bureaucratic cronies" and arrogant disciples of the ARRL retired?

Amateur radio is a hobby and is supposed to be fun for everyone, not just for a select few who consider HF bands their private domain in an exclusive club created by a licensing arrangement deliberately formulated to exclude the majority. If you are tired of the emotional cost, the endless frustration and the contemptuous attitude of those who support the present Morse code testing practices, you obviously no longer harbor the delusion that the code tests are for your benefit. For far too long, the majority of amateurs have been stymied, spurned and insulted, barred from total participation on all amateur bands by political favoritism initiated by a minority organization.

Current code testing practices no longer facilitate the society of amateur radio operators. Old ways may have been adequate years ago, but to survive into the future, amateur radio must face the reality of today's communications technology and be responsive to the innovations and ingenuity that even now is evolving around the world.

Reprinted from *The Code-5 Review*, published semi-annually by Guy Matzinger KB7PNQ.

NEVER SAY DIE

Continued from page 4

things which benefit all of us and for which, therefore, the hat should be passed for their development and maintenance.

In addition to military protection, a large contributor to our quality of life lies in developing and maintaining our industrial strength. Business. And here one obviously critical factor is the education and skills of our people. Our workforce. And this is every bit as important in the long run to our quality of life as the maintenance of our military strength. So yes, we need to pass the hat to pay for the education of our people. Note that I didn't limit that to children.

Once we graduate from our "free" public school system we are forced to pay for our own further education, so we make that investment because we see the potential for a personal benefit. But, in fact, everyone benefits to some degree, so perhaps it's reasonable to include some public contribution to further education.

Of course, one of the major problems with the government collecting for any service is the inefficiency of this funding system. Between administration, the natural application of Parkinson's Laws of growth to any government institution, and fraud, we're lucky to see 10 cents of any tax dollar collected end up where we intend it. There is plenty of room for improvement of this function of the government.

While it is in the interest of the public to keep government costs low, there is also an interest in educational efficiency which will permit the maximum transfer of information and skills to individuals at the lowest cost. And fighting all this is the momentum of the present bureaucracy which has gradually accumulated and solidified around the American school system, making it difficult to even consider major changes.

From what I heard during Economic Development Commission hearings from professional educators and college presidents, and what I've read as a result, I believe it's possible for our school costs to be cut at least in half—while, at the same time, we improve the product enormously. College tuition, using a plan I've proposed, can be eliminated entirely, with a concomitant reduction to three years and a resulting development of skills and information that's double to triple the current results.

Of course, with colleges, this would mean a reduction of their investment in paid sports teams and amenities such as golf courses and airports, the things which have driven the cost of some college "educations" over the $100,000 mark. The actual amount of education money buys is questionable, and not supported by international surveys.

Indeed, as I've pointed out in my *Making Money, A Beginner's Guide*, a college education equips you mainly for a job which will never make much money. Few successful entrepreneurs bother to finish college. Little that is taught (?) in today's colleges has any relevance to success in small business, and that's where the money is.

Building Skills

After reading Dan Greenberg's book, *Free At Last – The Sudbury Valley School*, I got all excited over what looked to me like possibly one of the best schools in the world. So I sent for, and read, five more books about the school. It's only a couple of hours from where I live, so I should get down there and see for myself what they're doing.

I love the idea of kids being able to learn what they want, without there being any formal curriculum: courses, grades, tests, and so on. In reading about the graduates I was struck by their success in a wide variety of fields, but I was disappointed that none that I read about were *outstandingly* successful. I expected to see some amazing successes.

I know you're not going to believe this, but this almost got me to thinking. The missing element, I suspect, is the taking advantage of children's natural curiosity by exposing them to a wide assortment of ideas as part of the plan, and not just hope that fate will do the job. Some of these kids might have a ball with amateur radio, if they knew about it. And ditto many other hobbies and interests.

When I was in the navy going to electronics school a submarine captain came in one time and gave us a talk about the submarine service. I had never considered it before that. So I volunteered for subs when graduation time came. I was disqualified on the medical, which is a fascinating story in itself, but I lied about it and went happily off to get myself killed in a 300-foot-long pipe.

In my *Declare War* book I proposed establishing a school much like the Sudbury Valley School, except that I wanted to have videos available for kids which would explain what the fun and benefits would be if they got involved with learning this or that subject, or developed some skills.

In my book I didn't list all of the skills I could think of, so this time I made a more comprehensive list of skills that I think would be of value for kids to build. Look over the list and let me know what I've missed.

How many of these skills had you mastered by the time you got out of college? By "master" I really mean to be at least adequate at. Most of these skills require instruction from an expert. I've found that it doesn't take very long to get as good at some skill as the average person in the field. I generally like to take the extra time and effort to be better than 90% of the people with that interest. The next 9% takes ten times as much effort, so I generally don't bother. I like to be

Continued on page 47

73 Review

Number 40 on your Feedback card

Hamtronics' TA-51 Exciter Kit

Perk up your foxhunts with this project.

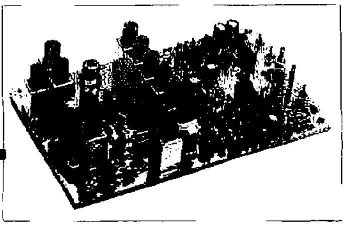


Photo A. The assembled TA-51 exciter board.

Larry Antonuk WB9RRT
P.O. Box 452
Marlborough NH 03455

Over the last couple of years our small foxhunting group had been growing by leaps and bounds. Starting with just a couple of experimenters, our group now numbered over a dozen. We all enjoyed the thrill of the chase, but the main focus of the group was building, testing, and experimenting with new antenna and RDF (radio direction finding) designs.

Hunt troubles

Things had been going well in general, but over the last few hunts we'd had problems. Three of the last five hunts had to be called off or modified because our fox transmitters had failed during the hunts. In one case we were using an old thumbwheel-type handheld as the fox. Apparently the thumbwheel contacts were dirty, causing the transmitter to jump channels intermittently. This made the transmitter mysteriously drop off the air at strange intervals, and caused some trouble for the packet channel the rig was suddenly transmitting on. One of the group then built up a little postage stamp-sized transmitter. This worked OK, but the frequency began to drift as the battery voltage dropped. The hunters with the synthesized rigs were able to follow the transmitter down the band, but those of us with rock-bound rigs were left on the wayside. As a last resort, one of the guys donated an old mobile rig, matched up with a car battery. It was still putting out about twenty watts, so he hid the high-power fox in the next county, using a timer to turn it on right at noon after he returned to the starting point. It was a great idea, but the second time the rig keyed up the high amount of RF got into the IDer/timer, locking it up and causing the rig to go into constant PTT. This made for easy hunting, but after about half an hour the finals burned up—turning our high-power mobile into a QRP rig.

"(Before the TA-51)... our frustration level was running high..."

At this point our frustration level was running high. We were spending more time fixing our crippled foxes than we were building antennas. At our next informal meeting we came to the obvious conclusion—we needed a decent fox. Of course, no one stepped forward to donate a new handheld. No one wanted anything to do with the flea-power one-transistor boards. A few mobile rigs were offered, but they were too big to mess around with. We ticked off the requirements. The transmitter had to have between one and five watts output for the best use around our area. It needed to be rugged—continuous duty, just in case we had another controller failure. Crystal control was OK, since we always used the same channel for the hunt. And of course, it needed to be reasonably priced (OK, cheap or free would be best).

Enter Hamtronics

One member of the group, who works for a commercial two-way outfit, mentioned the use of a Hamtronics exciter. His company had used several of the exciter boards as fixed transmitters in RF link applications. They were continuous duty at two watts, and met all of our requirements at a decent price. At our next weekly breakfast he

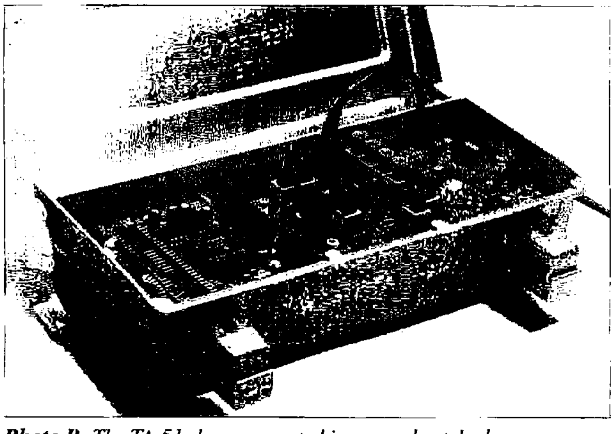


Photo B. The TA-51 shown mounted in a surplus telephone company connection box. The exciter board sits atop the battery pack, with the ADAPT-11 microcontroller mounted in the front of the box.

brought in his catalog, and we chose the TA-51. The TA-51 was the companion transmitter to the R-100 receiver (see *73*, February 1996) designed for repeater or RF link applications. We passed the hat for contributions, and anxiously sent off the check to Hamtronics.

The unit was shipped directly to our resident kit fanatic, so the rest of the group never saw the exciter in unassembled form. It was proudly displayed at the following breakfast—assembled, tuned, and tested. According to the report, the assembly went without a hitch. In appearance the TA-51 looks very similar to the R-100: the same glass-epoxy PC board, the high-quality components, the easy-to-tune coils. The TA-51 uses eight transistors in the RF section, and a single op amp IC for audio processing. Our RF wizard had a service monitor for tune-up, but indicated that standard equipment would make it just about as easy—a voltmeter, a dummy load/wattmeter, and a current reading power supply. The A28 tuning tool is mandatory; there's no other way to adjust those slugs with the square holes. One other point that was appreciated by the builder and the group was the use of a high-quality, ten-turn piston cap for warping the crystal. This made it a cinch to adjust the transmitter frequency right on, as opposed to the single-turn caps we'd been used to on the handhelds and mobile rigs (in addition to being tricky to adjust, the single-turn caps were very susceptible to jarring and bumping—one drop of the fox, and we were off on another channel).

"No problems—even after that ten-foot drop..."

Once it was built and aligned, we took an evening and installed the TA-51 in our fox "cabinet," a surplus telephone company connection box. The box was waterproof, easy to mount or hide, and just the right size for a small handheld or the TA-51, along with the IDer and a large NiCd battery.

New IDer, too

The IDer itself was something of a home-brew device. It was built using the ADAPT-11, a 68HC11-based microcontroller, and programmed to key up the transmitter and send Morse IDs. The transmitter was keyed by toggling one of the 68HC11 output ports, and the audio tones were created by toggling an output port at 1000 Hz, then keying this on and off to create the dots and dashes. Our resident computer guru set up the ADAPT-11 to create a pseudo-random PTT time, so the hunters were never quite sure when the signal would pop up, or how long it would last. In addition to the timing challenges, our guru found that you can vary the power output of the TA-51 by simply dropping the B+ voltage down to 11 volts. His next plan is to raise and lower the output power of the TA-51 intermittently, in order to further confuse the hunters. Once mounted in the telephone company box, the fox is easily hidden or, as in one case, not hidden at all. Mounted at the ten-foot level on a telephone pole, the box fit in so well that most hunters passed by or circled the pole several times before identifying the fox.

While exhaustive field tests are not yet complete, the new TA-51 fox has participated in three hunts with no problems—even after the ten-foot drop from that telephone pole on hunt number two. Perhaps the best measure of success is the fact that the topic of our weekly breakfast discussion is now turning back to how to make better antennas and RDF rigs, rather than how to get a fox we can rely on!

The TA-51 VHF Exciter kit is available for $99.00 from Hamtronics, Inc., 65 Moul Road, Hilton NY 14468-9535. Phone: (716) 392-9430.

Small Loop Design for HF QRP

A practical approach.

Jay M. Jeffery WV8R
3819 Parkdale Road
Cleveland Heights OH 44121

It's nice to be able to make perfect small loops using metal tubing and motorized split stator capacitors, and to be able to weld everything neatly together, but not everyone wants or needs such elaborate antennas. In fact, for QRP operation, the weight and complexity of the very efficient loops is often not desirable. A wire loop, on the other hand, is a light, simple, device that can be built quickly and easily and can be repaired with a few basic tools. It needs only an ordinary variable capacitor, and it's easy to take in the car.

For the QRPer in an apartment, a manually-tuned wire loop hidden behind a wardrobe is more appropriate than a heavy monstrosity that must be operated by means of a control box even though the antenna is only a few feet away. Also, a wire antenna can be put together for just a few dollars—even less if you have a junk box and some leftover furring strips.

It works both ways

To design and build small wire loop antennas, I had to come up with a quick, easy way to estimate the inductance of a wire loop where the length is known. On the other hand, if a specific inductance value is known, the required length would be easy to calculate using the same formula. The range of the formula would have to include loops with a circumference of seven feet to 38 feet. In this range, "small" loops are still small relative to the size of a room or an attic space. Of course, 38 feet may be hard to accommodate, but it is still possible.

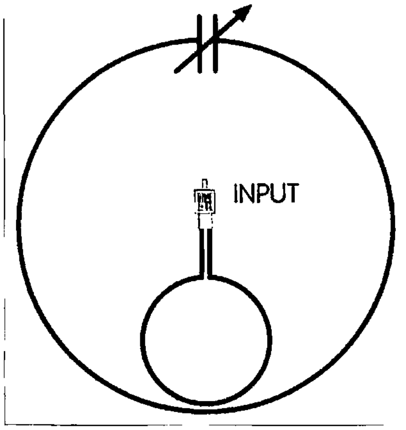


Fig. 1. Circuit diagram.

The simplified formula is a linear approximation of a more complicated formula which can be found in *The ARRL Antenna Handbook*. The more complete formula (slightly modified) is:

$$L = .019S\ (7.353\ \log_{10}\frac{96S}{\pi D} - 6.386)$$

where S is the perimeter of the loop in feet, D is the diameter of the wire used in inches, and L is inductance in µH. This formula can be used for values outside the range given for the shortcut formula.

The simplified formula is L=.45S - .5, where L is the inductance in µH and S is the perimeter in feet. Solving for S in terms of L, we get S=2.22L + 1.11. These formulas are approximate but easy, and close enough for practical use. They assume an AWG #12 wire size but would work for wire slightly larger or smaller. The wire recommended for this purpose is #12 stranded, insulated house wire, cheap and readily available.

More numbers

Given the size of a loop and a capacitance value, the inductance can be calculated for a particular band, or for several bands using the extreme frequencies, L=.45S - .5 and the formula:

$$f = \frac{10^6}{2\pi\sqrt{LC}}$$

where f is the frequency in kHz, L is the inductance in µH, and C is the capacitance in pF. Some useful versions of this basic formula are the following:

$$C = (\frac{10^6}{2\pi f\sqrt{L}})^2$$

$$L = (\frac{10^6}{2\pi f\sqrt{C}})^2$$

The formula that solves for L is appropriate when you have a good variable capacitor and want to determine what size of loop you need for certain frequencies. You simply substitute the L value in the length formula (S=2.22L + 1.11).

Beside the formulas, some rules of thumb are helpful in making small loops. The size of the loop should be large enough to be relatively efficient and large enough to tune easily. For easy tuning, you don't want to be tuning at the extreme values of the capacitor. For efficiency, experience has taught me that a 10-20 meter loop works well if its length is no smaller than seven feet. A 20-40 meter loop should be no smaller than 11 feet. A 30-80 meter loop should be no smaller than 22 feet. For indoor use, a vertical loop is the best choice.

Impedance matching

Small loops require an impedance matching device. The simplest approach is a small input loop placed inside and very near the main loop (**Fig. 1**). In practice, using insulated wire, the lower part of the input loop can be taped to the bottom of the main loop. This allows for fairly close coupling and for added mechanical rigidity. The coax is attached to the input loop and is placed so that it comes away from the plane of the main loop at a right angle. The input loop should be about one-fifth the size of the main loop or smaller, but experiment for your own best results.

Try a project

To show the use of the previous information, let's design a 20 through 40 meter

loop for use in an apartment, a home, or even outdoors (an outdoor antenna would require weatherproofing, however).

Assuming that you have an eight through 100 pF air variable capacitor available, the required inductance can be calculated using:

$$L = \left(\frac{10^6}{2\pi f\sqrt{C}}\right)^2$$

Using the lowest frequency to be used (7,000 kHz) and somewhat less than maximum capacitance (say, 90 pF), the inductance turns out to be around 5.74 µH. Using S=2.22L + 1.11, the length is approximately 13.9 feet or about 167 inches. This would be a square approximately 41.7 inches on each side. A circular loop, using D=C/π, would have a diameter of about 53 inches.

At the higher end of the frequency range, C=18 pF (somewhat more than the absolute minimum). Then, using the formula for f, specifically,

$$f = \frac{10^6}{2\pi\sqrt{LC}}$$

we come up with 15,700 kHz. This means that the antenna should easily accommodate 20 through 40 meters.

Finally, the input loop length is 167/5 inches or about 33.4 inches.

Testing the loop

First, the wire for the two loops should be cut to the calculated lengths and laid out on a wooden floor (or somewhere that won't involve a lot of metal mass). Temporarily mount the variable capacitor in a plastic box or the like and connect it to the main loop. Connect some 50 ohm coax to the input loop and place the loop very close to the main loop.

Now, connect the plug of the coax to a receiver set first at 7,000 kHz. By adjusting the loop capacitor, you should be able to find resonance points. If you have resonance, the background noise will maximize and signals should be easily heard on the band. Note that the resonance points are sharply defined, so tune slowly. If the loop doesn't tune the band, pruning or adding some length should fix it depending on which band is missing. Repeat this procedure for the highest frequency desired—in this case the top of the 20 meter band. If the SWR is too high, try pruning the input loop.

If the size of the loop is satisfactory, then you can design a framework to hold it. Almost any polygon will do, although a circle or an ellipse can be managed by using solid house wire, #12 or larger, which will hold a curved shape. A single mast can support the loop, but a spreader will make it more rigid.

If you think this particular loop is too large, get a larger capacity variable and design another loop to fit it.

Another approach

Another way is to begin with the size of the loop you prefer. Knowing the size, you can compute the approximate inductance. With the inductance and the frequencies, you can determine the size of the variable capacitor you need. There are variable capacitors available from several places including Surplus Sales of Nebraska, Mouser, Ocean State, or Antique Electronic Supply. Ocean State Electronics has some excellent trimmers that can be used. Trimmers give you a wide choice of capacitance ranges and breakdown voltages, and they are harder to tune, even with an alignment tool—but they *are* relatively cheap.

Capacitors obtained from an old tuner work well as long as the power levels don't exceed 10 or 15 watts. Capacitors with higher breakdown voltages are required for QRO.

Don't make the loop too small!

I recommend (from experience) that loops should be 8% of the wavelength of the lowest frequency you intend to use or more. About an eighth of a wavelength is better, but the antenna gets rather large, especially for 80 or 160 meters.

Finally, here is a warning: Don't forget that an antenna should not be touched while it is in operation. Even at low power levels, not to mention high ones, there is danger. Please take safety precautions. A loop sitting on the floor in your house is very accessible to pets and people.

On your own

You have enough information now to design, test and build your own small loop antennas—the best way to learn about them. This way you can get exactly the kind of small antenna you want. 73

Number 44 on your Feedback card

Power Monitor/Distribution Panel

Build this early warning system.

J. Frank Brumbaugh KB4ZGC/W4LJD
Box 30 - c/o Defendini
Salinas PR 00751

Very few station power supplies or transceivers are equipped with meters to monitor voltage and current, yet knowing the level of both is important and often provides the first warning that something is wrong. Of course, omitting these meters reduces the cost and size of power supplies, many of which will be tucked out of sight under the operating desk or on a high shelf and seldom glanced at after being turned on. Also, as we all know, the front panel of the usual commercial transceiver teems with so many knobs, switches, and push-buttons that there's no room for these useful voltage and current meters. Omitting them also reduces manufacturing costs.

Every ham should know whether the regulated voltage from the power supply is steady and at the correct level. An unusual variation is a warning and should be investigated immediately.

Murphy's Law being what it is, occasionally the power supply regulator can quit, allowing the output voltage to soar to dangerous levels. Although some commercial power supplies contain protective circuits to prevent this, some do not. Also, many home-brewed regulated power supplies may not be protected from the results of regulator failure at all. Therefore, to protect your transceiver as well as your bank account from major damage, this panel includes a means of monitoring the DC voltage and automatically disconnecting it from the transceiver should the voltage exceed a safe pre-set level. A fuse alone would not open the circuit rapidly enough to prevent damage, although a fuse should be included in the positive DC lead.

Because many ham and/or satellite stations have more than one transceiver as well as many other pieces of equipment, separate parallel branches should be available to distribute DC voltage to all present and planned equipment to be powered from the main station power supply. Additional "goodies" can easily be incorporated, such as regulated low voltages to power accessory equipment.

The panel described here provides all the amenities described above. It can often be constructed entirely from a well stocked junk box, but for those few who lack a well filled one, I'll tell you where to purchase the most expensive components, the meters, for little more than pocket change. Except for the panel itself, which can be a flat panel, an aluminum chassis, or a home-brewed enclosure, the total parts cost should not exceed ten dollars. This is very inexpensive insurance for expensive equipment which also provides maximum flexibility in monitoring and routing DC operating voltage to your equipment.

The circuit

Fig. 1 illustrates the schematic diagram of this panel. Aside from its primary functions of monitoring, distributing, and automatically disconnecting power from the load(s), should the voltage soar out of bounds, it includes optional but very handy outputs at the three most useful regulated voltages often needed for accessories but not directly available from the station power supply.

Regulated DC voltage from the station power supply is applied to the positive and negative input terminals of J1. A barrier strip is shown, but separate DC input and output connectors can be used to replace the barrier strip and eliminate the exposed voltage terminals. This input voltage is bypassed where it enters the panel by capacitors C1, C2, and C3, which eliminate incidental noise or spikes generated externally or internally. Positive voltage from J1 passes through fuse F1 and the normally-closed contacts of relay K1, then through current shunt R2 which is in parallel with ammeter M1, to the power output terminals on J1. Negative (ground) terminals on J1 and all grounds in the panel are connected to the station ground. Output terminals for three distribution lines are shown. You may install however many you wish. Meter M1 will display the total current drawn by loads connected to the output terminals when they are turned on. Positive voltage at the output of the shunt R2 is also applied to the suppressed-zero, expanded-scale voltmeter M2. This meter indicates a narrow range of voltages around the nominal power supply voltage as chosen by the builder. This will be explained later.

The input DC voltage is also tapped off between fuse F1 and the moving contact of relay K1 and applied to the automatic voltage monitoring circuit consisting of R1, D3, Q1, and K2. When R1 has been properly adjusted and the DC voltage exceeds the level chosen by the builder, D2 avalanches and applies a positive voltage to the base of Q1, driving it into saturation. The coil of K2 is the collector load for Q1, whose collector current energizes K2 and closes its normally open contacts. This applies operating voltage to

relay K1. K1 then switches and opens its normally-closed contacts, removing the DC input voltage from all output terminals as well as the panel monitoring circuits, and both meter needles will fall to the left end of the scale. The input voltage, now somewhat excessive, maintains both relays in their operated positions, without damaging the monitoring and control circuit, until the power supply is turned off. Because the normal elapsed time between a power supply malfunction and its being turned off by the operator will probably be only a few seconds at most, the monitoring circuit will not be adversely affected.

Three optional three-terminal regulators, U1, U2, and U3, derive their input voltages from the input side of shunt R2 and ammeter M1, so the current drawn from these regulators will not be monitored on M1. Voltages of 5, 6, and 9 are suggested as being the most useful if this option is included. Each low regulated voltage should be available at two or three parallel-connected output connectors, such as coaxial power jacks, to provide flexibility in powering small accessories.

Although not indicated in **Fig. 1**, a low-cost AC line voltage monitor which indicates AC line voltage from 90 to 130 VAC is recommended if you have space (see "Line Voltage Monitor," *73*, January 1996, page 86). Unfortunately, the schematic diagram was inadvertently omitted and is reproduced in **Fig. 2**. This will add about three or four dollars to the overall cost of the panel, and will provide a warning if the line voltage falls too low or rises too far.

Even if you have a large budget and have your heart set on nice, neat, high tech digital meters to use for M1 and M2, I very strongly recommend using analog meters instead. A digital meter, while extremely accurate, must be inspected closely to see just what its indication is. An analog meter merely needs a quick glance at the position of the needle to assure you that all is well.

Because new analog d'Arsonval meters are extremely expensive, I suggest you order a "grab bag" of five very high quality surplus meters from: Fair Radio Sales, Inc., PO Box 1105, Lima OH 45802. Phones: (419) 223-2196 and (419) 227-6573. 24-hour FAX: (419) 227-1313. Ask for Catalog No. WS97.

The meters you will receive will be of their choice, not yours, but all will be high quality, name brand meters, with basic movements ranging from 100 μA or less to 1 mA; at a couple dollars each for top quality meters, you can hardly go far wrong.

Fuse F1 should be commensurate with the maximum current your power supply is rated to deliver. Most 100 Watt transceivers draw about 20 Amperes on peaks, so a standard 20A fuse is sufficient. However, if you use modes requiring constant full power output, a slow-blow fuse or a standard fuse rated a bit higher might be the best choice.

Relay K1 can be single or double throw as long as there are closed contacts when the relay is not energized. The contacts must be rated to switch the maximum current expected to be drawn by the load. A DPDT relay with 10 Amp contacts can have the contacts connected in parallel to form a 20 Amp relay. Its coil is rated for 12 VDC.

Relay K2 has very little work to do and its contacts handle only the coil current of K1. A small DIP relay is ideal, and half-Amp contacts are sturdier than needed.

Construction

Just how this panel is constructed depends entirely upon the size of the panel or enclosure and on the size of the meters. The only cautions which should be observed are when connecting C1, C2, and C3 directly across the point where the DC voltage input is applied to the panel, and when routing the heavy wire lead between R2 and the K1 contacts and from R2 to the output terminals on J1. These two leads must connect to the ends of the shunt R2.

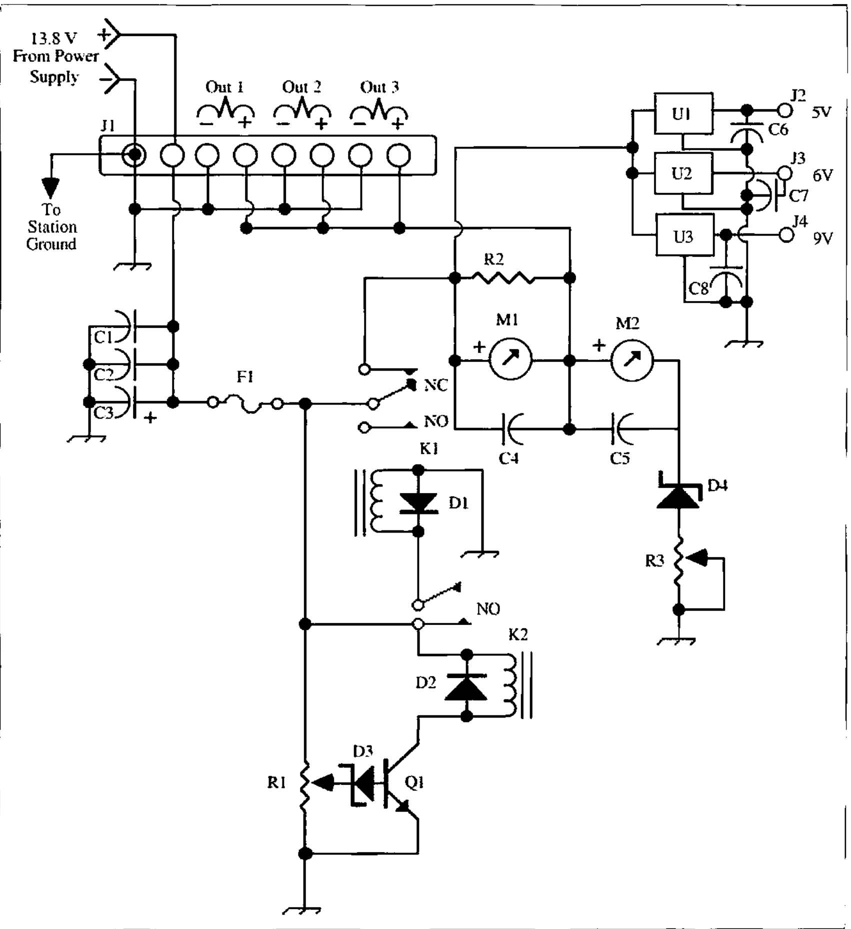


Fig. 1. Schematic diagram of the power monitor/distribution panel. Relays shown not energized.

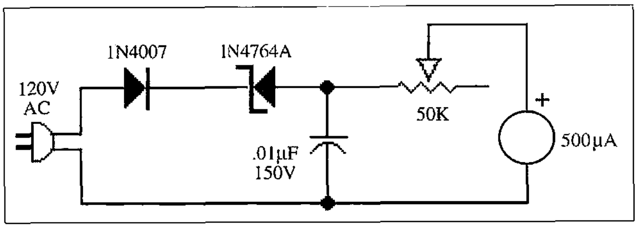


Fig. 2. AC line voltage monitor (optional).

Because there's little chance that the scales on the two meters you use will be exactly what you need, they cannot be mounted until the scales have been modified to fit your requirements and any internal rectifiers, shunts or multiplier resistors have been removed. To accomplish this you will need far more information than can be included here, but do not despair! (See "Use Those Surplus Meters," 73, January 1992, page 42.) If you do not have a copy or cannot locate one locally, back issues and photocopies of articles can be purchased from the publisher. That article has all the information you'll need to modify many different styles of meters.

When you have made the shunt R2 for M1 and changed the meter scale, both can be remounted and wired into the circuit. When M2 and its associated zener diode D4 and voltage adjust trimpot R3 have been determined and the meter scale modified to meet your requirements, these components can be mounted and wired into the circuit.

Before moving into the next section, check all your wiring and all soldered connections. Adjust R1 and R3 to place their wipers at the ground end of rotation.

Adjustment

Temporarily apply the DC output of your power supply to the input terminals of J1, maintaining correct polarity. Place the panel in the same relative position it will occupy when permanently installed, measure the DC voltage between the positive terminal of M2 and ground with a DMM (preferably) or accurate analog multimeter, and note the exact voltage. Adjust R3 so the voltage indicated on M2 is the same as that just measured. Remove the voltage from J1.

Determine the maximum DC voltage your transceiver or other load can withstand and still operate correctly. This will be found in the list of specifications in the operating manual.

Apply a source of variable, filtered DC voltage capable of being varied from below to slightly above the maximum safe level, and set that voltage from the variable source with your DMM or multimeter. Slowly adjust R1 and listen for the click when K1 energizes. Back off R1 until K1 clicks again as it opens, then readjust RI until K1 just energizes. Do this carefully and do not overshoot.

Now, slowly vary the input voltage a bit lower, adjusting very slowly so you can hear K1 click as it operates. Measure the input voltage again with your meter. It should be extremely close to the trip voltage set by R1. Very minor adjustments, made extremely slowly, of R1 may be required until you are sure the DC voltage will be interrupted should it exceed the tripping level you have established. This completes all adjustments. Operation will now be automatic.

Operation

Install the panel permanently where it can easily be seen from your operating position. Connect the DC input and output cables from the station power supply and other equipment to the panel connectors. When all cables have been connected and you are certain no errors have been made, turn the power supply on. The output voltage will be displayed on meter M2.

Then turn a transceiver on. The current drawn in the "Receive" mode will move the needle of M1 slightly up the scale. This will probably not indicate the exact value printed in the specifications. The latter is not exact and transceivers vary among themselves. Also, analog meters usually have a rated accuracy of ±2% of full scale.

Connect a dummy load to the transceiver, and plug in a key. The current indicated by M1 will be close to that cited in the specifications with the key closed. If you do not have a straight key, either a paddle or mike will serve to kick the needle on M1 around to let you see that all is working properly.

Now, turn everything off, get a cold "807" from the refrigerator, lean back in your chair and admire your handiwork. You can be secure in the knowledge that a glance at the meters will be reassuring, and that your expensive rig(s) will be protected automatically should Murphy interfere with your power supply regulator.

Parts List	
C1	0.001 µF ceramic disc
C2, C4, C5, C6, C7, C8	0.1 µF ceramic disc
C3	22 µF 25VDC electrolytic
D1, D2	1N4148
D3	5.6V 400 mW zener diode
D4	10V or 11V 400 mW zener diode
F1	Fuse
J1	Barrier strip or builder's choice
J2, J3, J4	RCA jack or builder's choice
K1	SPDT or DPDT 12V relay, NC contacts
K2	SPST relay, NO contacts, 12V coil, DIP or similar small relay
M1	Ammeter
M2	Voltmeter
Q1	2N3904 or similar NPN small signal transistor
R1	10kΩ trimpot
R2	Shunt
R3	Trimpot voltage adjust
U1	7805 regulator
U2	7806 regulator
U3	7809 regulator

One thing you should remember—if you notice the needle on M2 wiggling up and down on voice peaks or while keying—no regulator is perfect, and because M2 is an expanded scale meter these excursions are much smaller than they appear at first glance. 73

NEVER SAY DIE

Continued from page 39

good at things, but not *great*. Too lazy, I guess.

*Advantageous skills

archery
art: composition
art: drawing
art: familiarity with famous paintings
backgammon
baseball
bicycling
birdwatching
bookkeeping
bowling
boxing
car repair
cards: bridge
cards: cribbage
cards: poker
cat's cradle
cement making
conversation
cooking
dancing: ballroom
dancing: country
darkroom
desktop publishing
diving
dog training
dowsing
dressing for success
etiquette
fencing
first aid
fishing
flying
games: charades
games: chess
games: go
games: scavenger hunt
gardening
getting work
glassblowing
golf
hang gliding
horseback riding
hunting
ice skating
insect identification
Internet
interviewing
juggling
kite flying
knife throwing
knitting
knot tying
kung fu
languages: French
languages: German
languages: Spanish
leaf identification
magic tricks
map reading
meditation
metalworking
model airplanes
Morse code

Continued on page 59

The Insta-Flex 2 Meter Yagi Beam

Right at home in awkward places.

Darwin Ogden KB7WOS
790 West 800 South
Richfield UT 84701

If you have ever transported a yagi beam, or carried it through woods or underbrush, you know how the elements are always catching or getting damaged on something—so you will love the Insta-Flex Yagi Beam. It's inexpensive, easy to construct, and the elements can bend all over the place and still return to their proper positions.

The thing that makes the flexible elements and flexible gamma match possible is an everyday metal carpenter's tape measure. I had thought about using the tape measure for some time. The problem was designing a flexible gamma match. Thanks to suggestions from Dean Harmer WB7PRB and Berry Bradley WB7REL, the combination of flexible elements and gamma match, coax capacitor, and PVC boom came together.

"The elements can bend all over the place and still return to their proper positions."

I keep my beam in a fishing rod carrying tube behind the seat in my pickup. A cardboard mailing tube or PVC pipe would work just as well.

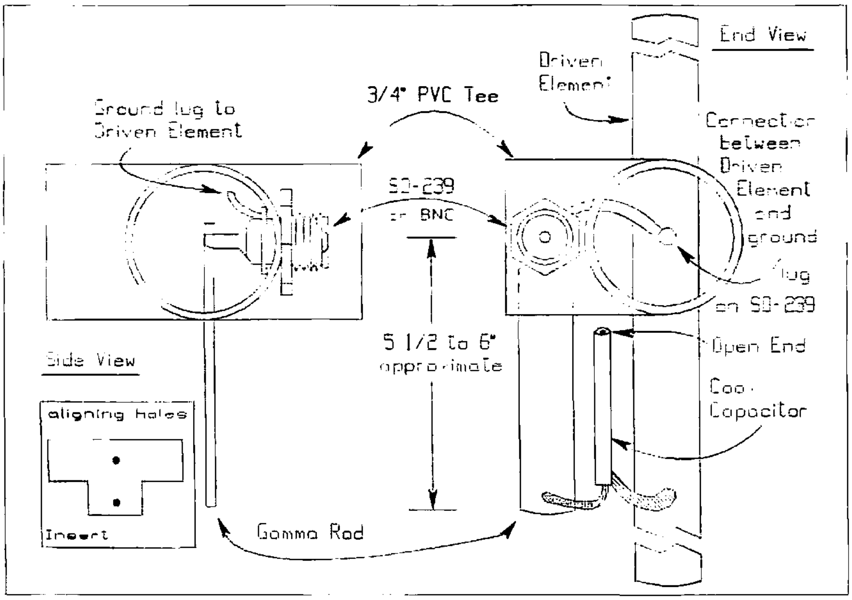


Fig. 1. Tuning the Insta-Flex Yagi, method A.

Setup is instantaneous: Just pull it out of the tube and the elements will spring into position. Connect the coax to the antenna and your radio and you're on the air.

Construction

As shown in **Fig. 1**, I drilled a hole in the 90° side of the "T" for the coax connector. I used a BNC chassis mount on the first, and an SO-239 connector for the second Insta-Flex I built. The BNC is easier to install, but requires an adapter (Radio Shack™ 278-120) to connect it to coax using a PL-259-type connector.

Place one mark on the "T" where the driven element is to be located and one where the gamma rod is to be (see **Fig. 3**). Drill a small hole at the mark, all the way through the "T" where the driven element and the gamma rod will go; this will make an aligning hole. The gamma rod can be mounted either way—up or down.

The curved slot for the elements and gamma rod can be made any way you want (**Fig. 3**). The easiest way I have found is to trace the curve of the tape measure on the PVC, and then use a scroll saw to cut the curve.

Another method is to melt it through using a piece of the tape measure and a propane torch. The curved slot is very important for the rigidity of the elements. If you make a straight slot for

the elements, they will lose their ability to spring back into position, because the natural curve will be taken out of the tape measure. Place the piece of tape measure to be used to melt the slot directly over the small aligning hole. Make sure it is perpendicular to the "T" as shown in **Fig. 3**. Heat the piece of tape measure about one inch above the PVC, and when it is hot enough, it will melt the PVC. Light pressure will help force it through. Don't press too hard; the tape measure will bend very easily as the temperature increases. You will probably have to turn the "T" over and do the same thing on the other side. Make sure of the direction of the curve, as the element will have to go through both top and bottom curved slots. After the PVC cools, fit the element.

Make the curved slots for the reflector and director(s) the same way. Attach the SO-239 or BNC with a wire connected to the ground lug, long enough to reach the center of the driven element. Now install the driven element and the gamma rod, and secure them with hot glue or epoxy. Solder the wire from the ground lug to the center of the driven element (**Fig. 1** or **2**).

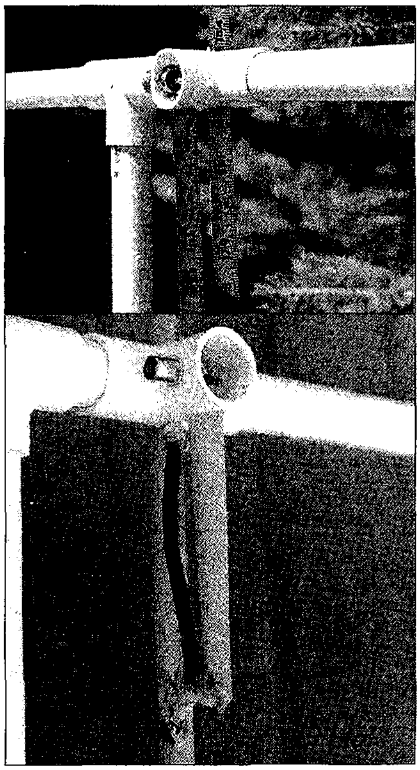


Photo A1, Photo A2. *Close-ups of gamma section.*

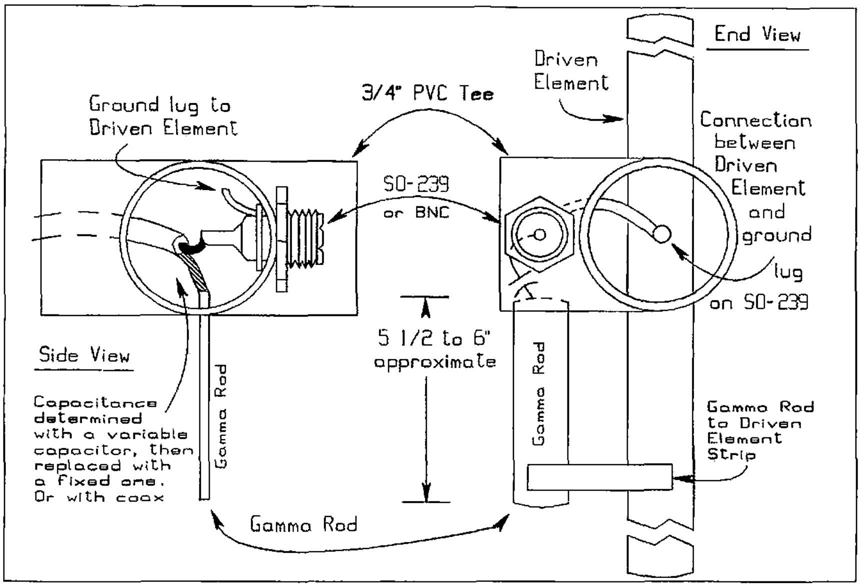


Fig. 2. *Tuning the Insta-Flex Yagi, method B.*

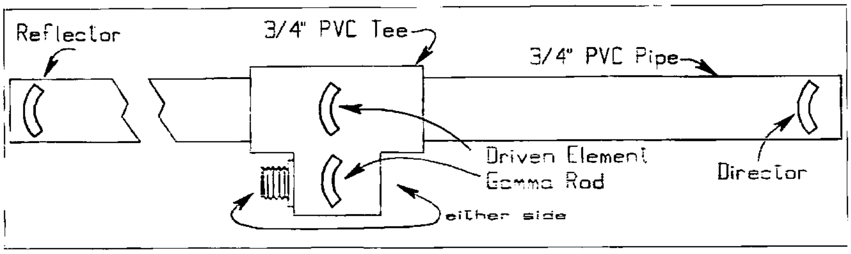


Fig. 3. Attaching the elements.

Use either method to complete the gamma match construction. Use a piece of coax to make the needed capacitance. If you use Method A, you may want to put a nonconductive support between the end of the gamma rod and the driven element.

Before securing the reflector and director(s), measure, cut and dry-fit the boom pieces into the "T"s. Once the proper spacing between elements is made, install the reflector and director(s) in the respective slots and secure them using hot glue or epoxy. Line all the elements up and press the boom pieces into the "T"s. You don't have to cement it together. If you do, make sure the elements and boom pieces are lined up *very* quickly; once the cement is set, you can't change it. I didn't cement mine and don't have a problem. If it comes loose, just line up the elements and press it together again.

Tuning

•Method A (**Fig. 1**): Connect the coax to the ends on the gamma rod and driven element as shown. Check SWRs and start trimming the coax off about 1/8" at a time. Check SWRs after each adjustment. After the lowest SWR reading is obtained, if it is not acceptable, try moving the attacking point on the gamma rod and driven element. You may need to trim a little off both ends of each element. It is better to cut the elements a little long and trim them than to have to replace them with longer ones. After the correct length of the coax capacitor is found, seal the open end with hot glue or epoxy. Make sure you leave the end *open*! Glue the coax capacitor to the side of the gamma rod. You might want to glue a piece of nonconducting material between the gamma rod and the driven element for added strength.

"Setup is instantaneous: Just pull it out of the tube and the elements will spring into position."

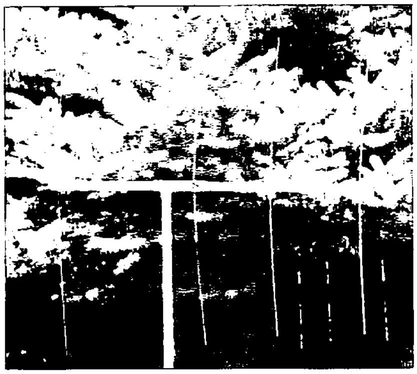


Photo B. The Insta-Flex in operation.

•Method B (**Fig. 2**): Use a variable capacitor (optional), and adjust for lowest SWRs. You may have to move the strip between the gamma rod and driven element up or down. After the correct capacitance is found, leave the variable capacitor in place, replace it with a fixed one, or use a coax capacitor. I've found it easier to replace the variable capacitor with coax and trim as needed. With both a three-element and a four-element, I have had better luck and faster tuning using the coax capacitor.

I have shown the Insta-Flex to lots of hams and have gotten lots of strange looks when they see what it's made of and how flexible it is. Try it—if you have comments, questions, or suggestions about improvements, I'd like to hear from you!

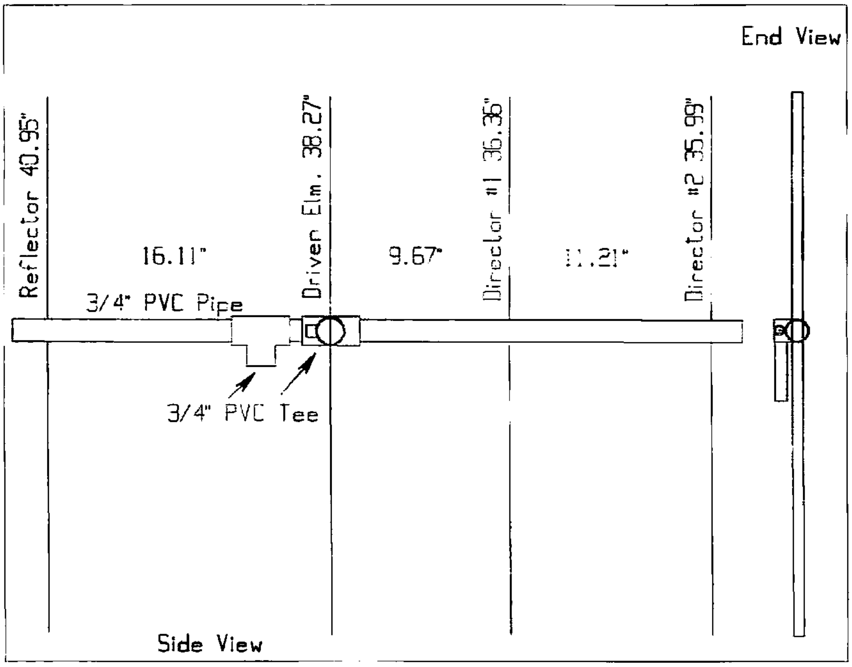


Fig. 4. Yagi for 3 or 4 elements.

Special Events

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the August issue, we should receive it by May 1. Provide a clear, concise summary of the essential details about your Special Event.

MAR 23

MADISON, OH The Lake County ARA will hold its 19th annual Hamfest 8 AM–2 PM at Madison H.S. on North Ridge Rd. The flea market will feature new and used amateur radio, computer and electronic equip. VE exams, forums, and an equipment test bench will be featured. Adm. $5 at the door. Table space $6 for 6 ft. table; $8 for 8 ft. table. Reservations for tables can be made by calling *Roxanne at (216) 256-0320.*

YONKERS, NY "WECAFEST 97" will be held 9 AM–2 PM at Yonkers Raceway, Central Ave. and Yonkers Ave. Pre-reg. of all vendors, including tailgaters, is recommended. Handicap accessible, door prizes, forums, food, more. Adm. $6. Call the WECA InfoLine at *(914) 741-6606, or write to Thomas Raffaelli WB2NHC or Jeanne Raffaelli N2NQY, 544 Manhattan Ave., Thornwood NY 10594.*

APR 4–5

ATLANTA, GA The Southeastern VHF Soc. of Cornelia GA will hold their 1997 conference at the Atlanta Marriott Northwest Windy Hill, located between Atlanta and Marietta GA (about 45 min. from Atlanta Hartsfield Internat'l Airport). Contact *Tad Danley K3TD* at *(770) 513-9252* or via *k3td@amsat.org.* The Web site is *www.akorn.net/~ae6e/svhfs.*

APR 6

OELOIT, IA The Denison Rptr. Assn. will host an amateur radio swap meet at the Deloit Community Bldg. in Deloit IA, 7 AM–2 PM. Adm. and tables $2. Talk-in will be on the KØCNM rptr. at 147.090. Reservations for table space may be sent to *Jim Currie KBØTLC,* or *Jim Slechta KAØHFR* at *Callbook* addresses. For more info, send E-mail to *John Amdor KD6MXL* at *johnmxi@netins.net.*

APR 10 AND 24

FT. WORTH, TX VE exams will be administered by the Lockheed ARC and the Kilocycle Club, 7 PM, at the Lockheed Rec. Area Facility, 2400 Bryant Irvin Rd. For details call *Ted Richard AB5QU, (817) 293-6745.* Some testing done by appointment only.

APR 11–12

TUPELO, MS The Tupelo ARC and Booneville ARC will co-sponsor the North Mississippi Hamfest and Computer Expo '97, Apr. 11th, 6 PM–9 PM; and Apr. 12th, 8 AM–5 PM. Location: The Mississippi Bldg. of the Tupelo Furniture Market Complex on Coley Rd. All-indoor hamfest/computer show, flea market, vendors, VE exams. Adm. $5, under 13 free when accompanied by an adult. Tables, $20. Contact *Jack Ellis KI5QV, Rt. 4, Box 198-B, Tupelo MS 38801. Tel. (601) 842-7255.* Talk-in on 147.38(+). Rag-chew on 147.24(+).

APR 12

FREDERICKSBURG, PA Northern Lebanon H.S. in Fredericksburg is the location for the 9th annual Hamfest and Computer Show being sponsored by the Appalachian AR Group. The event starts at 8 AM. General adm. $4, kids under 12 free. Indoor tables $14, tailgating $4. VE exams at 9 AM. Handicapped access. Morning seminars. Talk-in on 146.04/.64. Table reservations are recommended and must be prepaid. Tables not occupied by 9 AM are subject to resale. No refunds. Send check for reservations to *AARG, 105 Walnut St., Pine Grove PA 17963. Tel. (717) 345-3780.* Reservations may also be made with *Lanny Hoffman KD3TS, 337 N. 19th St., Lebanon PA 17046. Tel. (717) 274-2148.*

TRURO, NOVA SCOTIA, CANADA The Truro ARC will celebrate their 50th anniversary with a banquet at the Colchester Legion in Truro. Past and present members are invited to attend and celebrate. Reservations are required. A special QSL card has been issued for this historic event, and club members will operate with the special callsign prefix XK1 for the period Apr. 6th–19th. Contact *Dawn MacKay VE1MAK, 52 Spruce Dr., Truro NS B2N 4X6, Canada. Tel. (902) 893-3908,* or *E-mail dawn.mackay@nsac.ns.ca.*

APR 13

MADISON, WI The Madison Area Rptr. Assn. Inc. will hold its 25th annual Madison Swapfest at the Dane County Expo Center's new Exhibition Hall. Commercial exhibitors and vendors with 6 or more flea market tables will be admitted beginning at 3 AM; other flea market sellers will be admitted at 6 AM. Doors open to the public at 8 AM. New and used electronics gear. Talk-in on the M.A.R.A. rptr. W9HSY at 147.75/.15. Adm. $6 in advance, $7 at the door. Children under 10 admitted free. Flea market tables (2.5' x 6') are $15 in advance, plus adm. Reservation deadline is Apr. 5th. Contact *M.A.R.A., P.O. Box 8890, Madison WI 53708-8890. Tel. (608) 245-8890.*

RALEIGH, NC The Raleigh ARS will present its 25th Hamfest and Computer Fair in the Jim Graham Bldg., NCS Fairgrounds, 8 AM–4 PM. Wheelchair access. ARRL, MARS, ARES, NTS, QRP, and DX mtgs. Pre-reg. $5, $6 at the door. All inside. Tables and booths avail. Free parking. RVs welcome. Hospitality party Sat. night. VE exams, contact *AA4MY, (919) 847-8512.* For pre-reg. and dealer inquiries, contact *Ronnie Reams WA4MJF, 3509 Rolesville Rd., Wendell NC 27591. Tel. (919) 217-0263. Talk-in on 146.04/.64.*

APR 19

BELTON, TX A Ham Expo-Tailgate will be held at Bell County Expo Center starting at 7 AM. Adm. $1. Handicap access. Indoor tailgate spaces $10 at the door; setup begins at 6 AM. Vendor tables $20 ea. (reserve by Apr. 11th). Free elec. Commercial vendor Fri. eve. move-in surcharge, $10 per table. Sponsored by Temple ARC, 1802 S. 13th St., Temple TX 76504. Phone *Mike WA5EQQ, (817) 773-3590; E-mail: mlefan@vvm.com. Expo netpage—http://www.tarc.org.*

APR 20

CANFIELD, OH A giant outdoor flea market will be sponsored at the Canfield Fairgrounds, State Route 46 in Canfield OH, by the 20/9 Radio Club, Inc. Open 8 AM–3 PM. Free parking. Tickets $5 at the door. Inside tables $10 per 8 ft. Outdoor flea market free with admission. Talk-in on 145.275(-), 224.420(-), and 442.750(+). For more info, contact *Don Stoddard N8LNE, 42 S. Whitney Ave., Youngstown OH 44509. Tel. (330) 793-7072.*

APR 26

FLATWOODS, WV The 4th Annual Central WV Hamfest, sponsored by the Pioneer ARA, will be held 9 AM–3 PM at Braxton County H.S., I-79 Exit

67. Local motel available. Free parking. Dealers welcome. Tickets $5, flea market space $10 a table. First-come, first-served, unless reserved. Talk-in on 145.29 and 146.655. Contact *Ed Messenger N8OYY, (304) 462-5312;* or write to: *PARA/Hamfest, P.O. Box 301, Glenville WV 26351.*

HARMONY, NJ The 1997 Chenyville Hamfest will be held at Warren County Farmers Fairground on County Route 519 in Harmony. Open 8 AM–2 PM, setup at 6 AM. Adm. $6. Spouses and children under 12 free. Tables $20, indoor space includes electric. $10 outdoor tailgating space. VE exams $6.25. To pre-register and get details, call *Charlie Kosman WB2NOV at (908) 788-4080.*

SYRACUSE, NY "Spring Fest '97" will be held by the Liverpool Amateur Reptr. Club at the New York State Fairgrounds (Cattle Bldg.). The gate charge for anyone entering the bldg. is $5 per person. The bldg. will be open at 5 AM for vendors, 8 AM for tailgaters and the general public. Hamfest hours are 8 AM–2 PM. Vendors must exit by 5 PM. 8 ft frontage space $5 in advance, $10 at the door. Tables $7.50 ea. in advance, $10 ea. at the door. *Make payable to L.A.R.C.* and mail to *Tom Delasin WA2DAD, 4172A Burning Tree Rd., Liverpool NY 13090.*

APR 27

ARTHUR, IL The Moultrie AR Klub will hold their 35th Annual Hamfest at Moultrie/Douglas County Fairgrounds on the south side of Arthur, just off Route 133 behind the high school. Hours: 8 AM–1 PM. Adm. $4 per person over 14 yrs old. Tables $10 ea. in advance. No exams this year. Contact *M.A.R.K. P.O. Box 91, Lovington IL 61937;* or call for info *days, (217) 543-2178; eves., (217) 873-5287.* Talk-in on 146.055/.655 and 449.275/444.275.

FISHKILL, NY The ARRL Eastern New York Section Convention will be held at the Mt. Beacon Hamfest at John Jay H.S. in Fishkill. Ham radio, computer and electronics flea market. Adm. $5, spouses and kids free. Advance tables $8, $10 at the gate. Tailgating. Bring-your-own-table, $6 a spot. VE exams for all license classes. Talk-in on 146.97(-). Contact *Ken Akasofu KL7JCQ, 316 Titusville Rd., Apt. 4, Poughkeepsie NY 12603-2944. Tel. (914) 485-9617; Fax: (914) 485-2402. E-mail: Ken.Akasofu@bbs.mhv.net.*

MAY 3–4

ABILENE, TX The Key City ARC will sponsor the ARRL West Texas Section Convention and Hamfest at the Abilene Civic Center 8 AM–5 PM Sat., and 9 AM–2 PM Sun. Free parking. VE exams. Wheelchair access. Tables $6 ea. Pre-reg. $7 (must be received by Apr. 29th), $8 at the door. Talk-in on 146.160/.760. Contact *Peg Richard KA4UPA, 1442 Lakeside Dr., Abilene TX 79602. Tel. (915) 672-8889.*

MAY 4

HAGERSTOWN, MD The Antietam Radio Assn. will sponsor the Great Hagerstown Hamfest & Computer Show at Hagerstown Jr. College, Athletic, Rec., & Community Center. Setup Sat., May 3rd, 6 PM–9 PM, and May 4th, 6 AM–8 AM. Volunteers will be available to assist. All vendors responsible for collecting applicable state tax. Proper tax and license certificates should be made available upon request. Outside tailgating spaces $5 per space. Adm. $5, children under 12 free. Tables paid in advance are $15 ea. A discount is available for 11 or more tables. Limited free electric hookups. Contact *ARA, P.O. Box 52, Hagerstown MD 21741. Tel./Fax (301) 791-3010.* VE exams at 9 AM, at no charge, by the Mountain VEC. Walk-ins accepted. For testing info, contact *Leo Patterson KQ8E, (304) 289-3576,* or *Gay Rembold W3DFW, (301) 724-0674.* Talk-in on 146.940/.520 simplex on the day of the event and on the night before.

MAY 10

GREENVILLE, SC A hamfest will be sponsored by the Blue Ridge ARS, 8 AM-5 PM, at the Anderson County Fairgrounds, E of Anderson on Hwy. 29 Business. Flea market, Buck Rogers, K4ABT SEDAN packet conference, VE exams at noon, overnight camping, free parking. Talk-in on 146.01/.61. Advance adm. $4; $5 at the door. Contact *Gene WB4ZBZ,* or *David KE4QQQ, (864) 476-2609, E-mail: ke4qqq@innova.net.*

MAY 15–18

DAYTON, OH The "Four Days In May"™ QRP Symposium on Thursday, May 15th, held in conjunction with the Dayton hamvention©, will kick off QRP activities at Dayton. Full day of activities on Thursday at the Days Inn Dayton South (513-847-8422); includes multimedia QRP presentations, catered lunch, door prizes, tech talks, tutorials by clubs. Thursday registration $30 before May 1, $35 after (if still available). Make checks *payable to "Bob Follett" and send to: Bob Follett AB7ST, 2861 Estates Dr., Park City UT 84060, E-mail: bfollett@ditell.com.* On Fri., May 16th, the QRP-ARCI Awards Banquet will be hosted by FDIM Banquet Chairperson Pete Meier WK8S. Please send $15 banquet ticket fee (US check, MO, internat'l MO) *made out to "Pete Meier"* by May 1st. Mail to *Pete Meier WK8S, 4181 Rural, Waterford MI 48329;* or *E-mail pmeier@tir.com.* Also on the 16th, Preston Douglas WJ2V will host the FDIM QRP Vendor Evening Social. To register, contact *Preston Douglas WJ2V, QRP Vendor Evening Chairperson, 216 Harbor View N., Lawrence NY 11559,* or via *E-mail: pdouglas12@aol.com.*

MAY 16-18

DAYTON, OH The Dayton Hamvention©, sponsored by the Dayton ARA, Inc., will be held at the Hara Arena. Fri., May 16th: Flea market open and bus service avail., 8 AM–6 PM; exhibits, noon–6 PM; forums 1 PM–5 PM. Sat., May 16th: flea market and bus service 7 AM–5 PM; exhibits 8 AM–5 PM; forums, VE exams, activities, 9 AM–5 PM; hamvention banquet at the downtown Dayton Convention Center, 6 PM. Sun., May 17th: flea market 7 AM–4 PM; bus service available 7 AM–5 PM; exhibits open 8 AM–2 PM; forums and activities 9:30 AM–1:30 PM; prize drawings 2 PM. Programs available Fri. at 7 AM in the Hara Arena lobby and in the tent in front of the East Hall entrance. Flea market spaces are sold in advance only; a maximum of 3 spaces per person (non-transferable). Limited to amateur radio, electronic, and related items only. Electricity available in a portion of the last flea market row for $60 a space extra. Tables and chairs not available. Contact the *Flea Market Chairman by FAX at (937) 253-1289, by E-mail at fleamkt@hamvention.org,* or by *voice mail at (937) 276-6932;* allow 30 seconds for the phone routing system to transfer the call. Registration tickets in advance $13, at the door $15. Banquet tickets in advance, $25; after May 17th, if available, $30. Flea market spaces $50/1 space, $110/2 adjacent, $220/3 adjacent; elec. $60 extra each space. Covered tent w/elec. $325 ea.

SPECIAL EVENT STATIONS

APR 18–20

CHARLOTTESVILLE, VA The Albemarle ARC will operate station WA4TFZ, 2300Z Apr. 18th–2300Z Apr. 20th, to commemorate the Charlottesville Dogwood Festival. Operation will be in the General portion of the 80, 40, and 20 meter bands, and the Novice portion of the 10 meter band. For QSL, send QSL and SASE to *Bill Bearden KC4TQF, 237 Falling Rock Dr., Stuarts Draft VA 24477 USA.*

APR 25–26

THOMASVILLE, GA The Thomasville ARC will operate W4UCJ 1700Z–2300Z Apr. 25th and 1100Z–2000Z Apr. 26th, to commemorate the 76th Annual Rose Festival. Operation will be in the lower portion of the General 80, 40, 20 and 15 meter phone subbands, and the Novice 10 meter phone subband. For a certificate, send QSL and a 9" x 12" SASE to *TARC/Rose Festival Station, P.O. Box 251, Thomasville GA 31799 USA.*

MAY 3–4

DANBURY, CT The 1997 Connecticut QSO Party will be sponsored by the Candlewood ARA, 2000Z May 3rd–2000Z May 4th, with a rest period 0400Z–1200Z. Phone, RTTY and CW. For operating rules, contact *CARA, P.O. Box 3441, Danbury CT 06813-3441 USA.* Please remember to send an SASE.

PHILADELPHIA, PA The Olympia ARC will operate WA3BAT from 1300Z May 3rd–2000Z May 4th, to commemorate the 99th anniversary of Admiral Dewey's triumph over the Spanish fleet at the Battle of Manila Bay. SSB/Phone: 3.898.5, 7.248.5, 14.248.5, 21.368.5, 28.368.5, 145.270 FM. CW: 3.710, 7.030/.110, 14.030, 21.040/.110, 28.025. For a certificate, send QSL and a 9" x 12" SASE to *Olympia ARC, Independence Seaport of Philadelphia, 211 South Columbus Blvd., Philadelphia PA 19106 USA.* 73

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

Free test signals

From Phil Salas AD5X: "Those little MFJ SWR analyzers also make great little portable signal generators for general testing purposes. In order to do their job as SWR analyzers, the units need to simulate a very low power CW transmitter, along with an equally sensitive SWR metering circuit. You can therefore use these little gems for general signal injecting or troubleshooting, as well as for antenna and transmission line analysis.

"In order to achieve a variable RF signal output, I've used a Radio Shack™ #15-578 variable 75-ohm TV attenuator, along with the appropriate adapters, to reduce the signal level to whatever I've needed for the particular troubleshooting job at hand. I also decided to open up the Radio Shack attenuator's case and replace the F-connectors with BNC connectors. Just another twist to make the attenuator even handier! And speaking of Radio Shack, I've found that their #21-506 50-ohm dummy load can be expected to work well up to about 500 MHz. It will handle 10 watts continuously, or even 100 watts for a few seconds at a time. I've put 100 watts into mine a number of times, getting it so hot that I couldn't touch it, and it doesn't seem to have damaged or degraded the unit's SWR in the least. Try not to overdo it, though!"

Hard-to-find variable caps

From John Nix: "If you find yourself in need of a fairly large, fairly expensive variable capacitor for that low frequency antenna tuner project you've been putting off, here's an idea you might want to consider adapting to your own requirements.

"Just as an example, let's assume you're looking for a 1,000+ pF variable cap... not the easiest thing to come by... but don't let that stop you. Variable caps in the 365 to 420 pF range are fairly common, so all you really need to do is to switch in additional 350 pF (or so) good quality (meaning stable) fixed capacitors, ones that will put you in the right range, until you have the value over the maximum value of your variable cap on hand. In other words, if you need a maximum of 700 pF, use a 365 pF variable and a 350 pF fixed cap in parallel... this will give you something in the area of a 380 to 715 pF variable. If you'd like to get up to a 1,000+ pF variable as mentioned before, use a 365 pF variable along with two paralleled 350 pF fixed capacitors, for a total of 730 to 1,065 pF variable. **Fig. 1** shows how to do this using just a two-pole, three-position rotary switch. Of course, you can substitute whatever actual values you wish for the various capacitors, and add more fixed 'jumps' by using a rotary switch with additional poles and additional positions; another pole and another click-stop position are needed for each fixed capacitor 'jump' above that shown in **Fig. 1**. It's worth keeping in mind for future use, even if you don't have an immediate need right now... it can save you some money that might have otherwise been spent on high-priced, hard-to-find high-picofarad variable caps!"

> ***"This sounds like it might be an excellent opportunity for a budding machinist/entrepreneur..."***

Hot stuff!

From Richard Measures AG6K: "The explanation that follows will help you to understand why the electrolytic filter capacitors in the popular Heath SB-220 linear amplifier, and others of similar design, are subjected to a higher-than-healthy degree of heat during 'normal' operation. The SB-220 is typical of many linears in ham shacks around the world, so these tips may well find applicability in yours, regardless of its actual brand-name and model number.

"A major source of heat applied to the electrolytic filter capacitors in the SB-220 is from the eight 30k, 7-watt voltage-equalizing resistors that are directly adjacent to the eight electrolytic filter capacitors used in the high-voltage power supply. A minor source of capacitor heating results from a 60 Hz ripple current flowing through each capacitor's inevitable internal resistance. In the SB-220, the filter capacitor heating problem is compounded by the fact that air cooling from the amplifier's fan doesn't directly reach the capacitors' metal cans... this is because the molded plastic covers that surround and insulate each electrolytic also act as thermal barriers. Some amplifiers use paper slip-on covers, but all use some form of insulating medium because of the high voltage on the metal cans themselves (since they're above ground in almost all cases). In the SB-220, I've seen this plastic insulating material actually melt in the areas nearest the eight 30k, 7-watt resistors! One can only imagine what the temperature inside the cap must be! It's worth mentioning that wet electrolytic capacitors will have their life expectancy reduced by a predictable amount for every degree rise over normal room temperature (70 degrees F). Many electrolytics are also marked as having a maximum permissible operating temperature... a temperature that should never be exceeded under any circumstances. By the way, that doesn't mean that the capacitor can be operated near that maximum without lifeexpectancy degradation, as mentioned before.

"It's interesting to note that the heat produced by these eight 30k resistors can be reduced by 570% simply by changing them to 100k, 2- or 3-watt metal-oxide-film resistors instead. This modification alone should greatly prolong the expected life of the eight filter capacitors in an amplifier like the SB-220. Other resistance values may be used, up to about 150k, provided the resistors themselves can withstand the voltage across them. Metal-oxide-film resistors of the 2- to 3-watt variety are

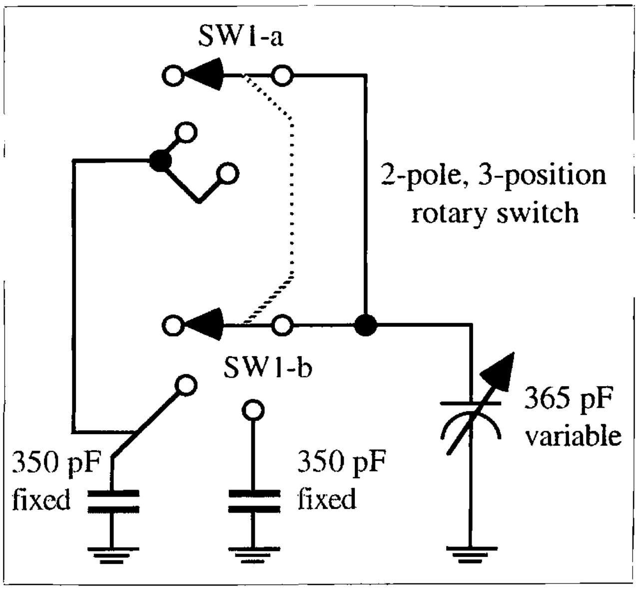


Fig. 1. Paralleled fixed capacitors, added to a variable capacitor via a rotary switch, will provide an (apparent) increased maximum value for the variable—see text.

often only rated at 350 volts maximum across the element, but this can easily be doubled by using two 50k resistors in series (in place of one 100k unit). Spiral-film resistors, if available, can also be used, since they'll withstand higher voltages across them than any other variety of resistor. By the way, I don't recommend using the older carbon composition types: they don't maintain their tolerances well with heat and age.

"Increasing the value of the equalizing resistors across the filter capacitors will also increase the 'bleed-down time' of the capacitors when the power is turned off. Therefore, be especially careful to allow enough time for the charge on the caps to bleed off by watching the voltmeter on your amplifier drop to zero. Then apply a reliable jumper lead from the HV anode terminal directly to ground to provide a sure ground path for the high tension point.

"Here's another caveat about something that can occur in some linears with an automatic shorting interlock switch, such as the Heath SB-220: It will spill the HV filter caps' charge directly into the grid-current metering shunt when a short is applied by the interlock switch action or by an external jumper to ground, if the charge on the caps has not been allowed to bleed off normally. If the meter happens to be in the grid-current position when this happens, it can be destroyed in short order under these conditions! So just opening the HV compartment can potentially (no pun) fry your amplifier's metering circuit—something you wouldn't normally think of unless you've seen it happen. That's another good reason not to leave the multimeter switch in the grid-current position and to not even go into your linear until the caps have had a reasonable time to bleed off their high voltage charge. So again, put the meter in the high voltage voltmeter position and keep an eye on it until it's safe to enter."

Moderator's note: One source for the metal-oxide-film resistors mentioned in Rich's piece is Digi-Key Corporation, 1 (800) 344-4539. As an individual, Rich has done an amazing amount of research into amateur HF amplifiers, their peculiarities and their shortcomings. I've found his "fixes" to be practical, and his procedural outlines should be manageable by the average ham radio hobbyist. As Rich said, please remember that anytime you're working around high voltage components you should take time to think about the safety procedures that must be followed. We tend to become somewhat complacent since most of our servicing is done on low voltage electronics these days, but the high voltage present in tube equipment is just as deadly as it ever was—maybe more so because of our current tendency toward complacency. I know that I have to keep reminding myself to go slowly and cautiously when tube anode potentials are nearby.

Easy in and easy out

From Mark Marholin KE6JJR: "For TS-50S and IC-706 (and probably most other rigs) mobile users, the standard screws used to attach the radios to their mobile mounts are 4mm x 20mm Phillips-head screws. This makes removal of your radio from your mobile mount inconvenient and time-consuming. Sometimes getting even a 'stubby' Phillips screwdriver alongside the radio's mounting bracket can be challenging.

"For a major improvement in this area, purchase 4mm x 20mm steel hex head screws and #4 thumbscrews from your local hardware store or home center. Cut off all but three or four threads on the threaded portion of each of the thumbscrews and screw them into the hex head of the 4mm x 20mm screws. This will be simply a friction fit, but it will hold the thumbscrew part to the hex head screw part temporarily. Now solder the thumbscrew part to the hex head part with silver solder, acid flux (not rosin flux) and plenty of heat. Clean the screws well when cool to remove all traces of the acid flux. Now you have 4mm x 20mm thumbscrews that make it a snap to install and remove your mobile rig from its mobile mount by hand."

Moderator's note: This sounds like it might be an excellent opportunity for a budding machinist/entrepreneur—supplying metric thumbscrews for a variety of uses in the amateur radio market. These are the types of recognizable business opportunities that Uncle Wayne has spoken of so often in his editorials. There are many such "gateways of opportunity," supplying simple but necessary

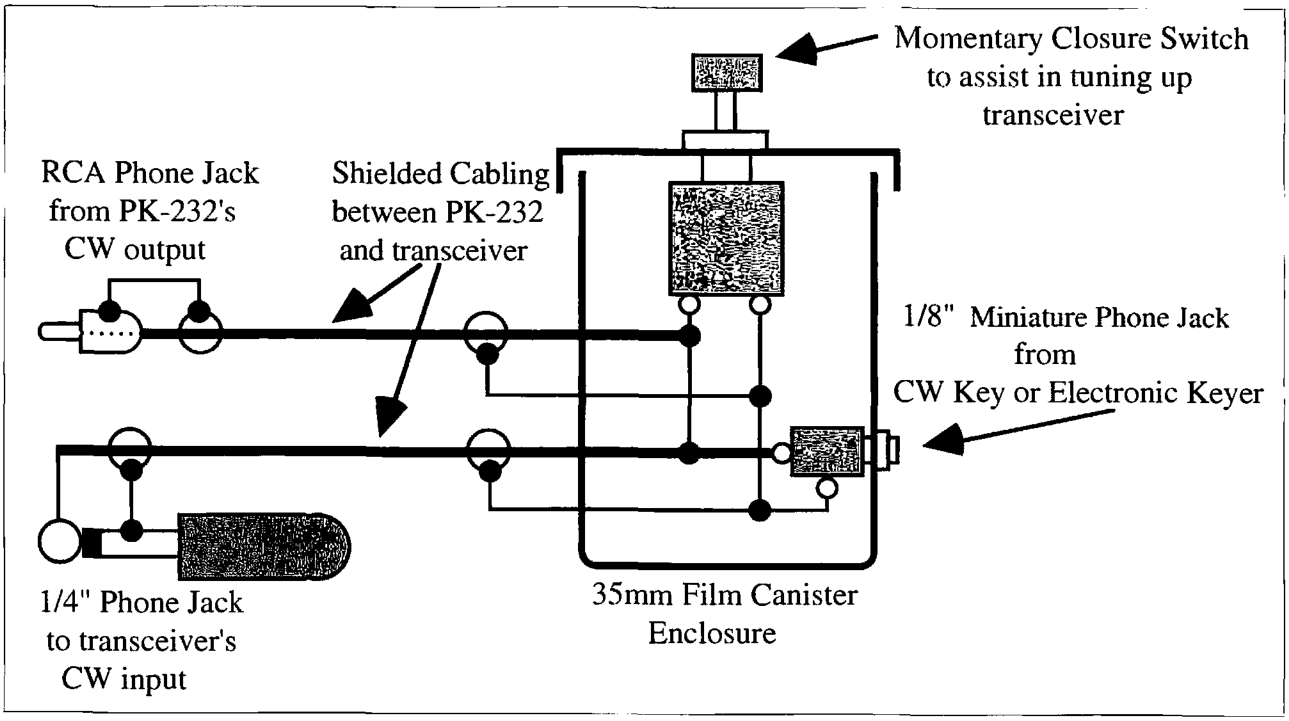


Fig. 2. AD1B's "Tune-up Assistant." See text for full details.

accessories to the amateur marketplace. They can sometimes lead to eventual independence from the need to get up every day and trudge off to the same job at someone else's place of business.

Photo opportunity

From Thomas Hart AD1B: "Being active on all bands from 160 through 2 meters, on a variety of modes, I decided to add a PK-232 terminal unit to my station to augment CW as well as the various digital modes of operation. Since converting over, I've found myself using my straight key and keyer very infrequently, relying instead on my computer and terminal node controller (TNC) for virtually all non-voice communications.

"For those times when I need to manually key the transmitter (for adjusting power output and for antenna tune-up), I've found this simple device (shown in **Fig. 2**) to be more than adequate. Basically, it consists of a discarded 35mm film canister, holding a momentary push-button switch, that can be used to key my transmitter, allowing me to make final adjustments to the transceiver/transmatch combination. There's also a miniature female 1/8" phone jack in the side of the canister for inserting a straight key, bug, or electronic keyer if desired... just for nostalgia.

"The few parts needed are readily available from any Radio Shack store and the layout is noncritical, quick and easy. Simply cut the line that presently connects your TNC to your rig's keying input and insert the circuit shown in Fig. 2 in parallel with that line. The entire project should take only a few minutes to complete... not counting the time needed to go to the store to buy the roll of film! The converted film canister stands on the shelf next to my Kenwood transceiver and has been very useful for my own operating setup. I hope that some variation on it will work for you just as well."

More small bulbs

From Andrew Gretchenuk: "A good replacement bulb for meters and dials in modern transceivers can be found in the type 2182 miniature lamp. The 2182 is rated at 14 volts at 80 milliamperes and has an average bulb life of 40,000 hours (that equates out to nearly five years of constant running!). If operated at somewhat less than 14 volts, the life expectancy will naturally increase. For instance, when operated at 12 volts, the 2182 lamp draws 75 milliamperes and will probably last 20 to 25% longer yet. Long life for our transceiver's bulbs is important, especially if the equipment is left running 24 hours a day, as in the case of most packet BBSs, digipeaters, and network nodes. The 2182 lamp measures about 3/16" in diameter and 7/16" long and comes with sufficiently long wire leads. It would be a good replacement choice for spots where that physical size doesn't preclude its use. Check out the Mouser catalog (tel. 800-992-9943; http://www.mouser.com) as one source for this lamp and keep a few of these bulbs on hand."

Check out this Web site

73 Amateur Radio Today's "Ham To Ham" column *past columns* are now available on the Internet Web pages at: http://www.rrsta.com/hth as a service to the column's readership. The site is being provided through the good graces of Mark Bohnhoff WB9UOM. Surf over and have a look!

Don't put off sending in your own favorite tips, ideas, suggestions or shortcuts to my address at the beginning of the column. To keep "Ham To Ham" lively and interesting I need more continuous input—your input. Just jot down whatever you'd like to pass on to others from your own experiences in our hobby and I'll do the rest. I'm waiting to hear from you.

•Murphy's Corollary: Whatever it is that you want to do, you must always do something else first!

Finally, a special thanks to all of this month's contributors:

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

John Nix
9123 Highway 23 NE
Foley MN 56329-9501

Richard L. Measures AG6K
6455 La Cumbre Road
Somis CA 93066

Mark Marholin KE6JJR
1588 Four Oak Circle
San Jose CA 95131

Thomas M. Hart AD1B
54 Hermaine Avenue
Dedham MA 02026

Andrew Gretchenuk
12233 Rosaro Avenue
Warm Mineral Springs FL
34287

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator nor by 73 for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to *73's* "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More TV

Last time, we examined the history and basic theory behind scanning a television image. Let's continue, this time looking at color and the makeup of the video signal.

The magic rainbow

As soon as fully electronic television began to take off in the marketplace—perhaps even before then—work began on adapting it for color. Borrowing from the old scanning disk concept, CBS created a color TV system that was a hybrid of the old and the new. It used a picture tube to create a monochrome image, with a rotating disk in front of it. This disk didn't scan the image, though. Instead, it was broken up into three sections, each consisting of a color filter for each of the additive primary colors: red, green and blue. The disk was automatically synchronized to the vertical scan rate of the incoming signal, resulting in the successive display of three pictures, one in each color. The human eye, which cannot sense color changes very fast, integrated all three pictures into one full-color image. It worked, but it had limited brightness, due to the light loss through the filters, and there was some flicker. And, just like with the old mechanical scanning system, it took a big disk for the size of the resulting picture to be acceptable.

Ultimately, an all-electronic system created by RCA engineers won out, just as all-electronic television itself had displaced mechanical scanning. But how the heck do you create colors on the face of a tube?

Rare earths

Just as the phosphors in monochrome picture tubes could be made to give off white light (well, OK, bluish-white), it was found that various minerals called "rare earths" would generate different colors when struck by an electron beam. With careful selection, it was possible to create red, green and blue phosphors. The trick now was to scan three separate images, with three separate beams, in one picture tube. How could you do that?

Playing the angles

The answer was simple geometry, combined with some high-precision manufacturing. The colored phosphor dots were deposited on the inside face of the picture tube in a repeating pattern, each group of three next to another. For many years, that pattern was a tiny triangle composed of round dots. Then, in the 1960s, the Sony Corporation invented and introduced their Trinitron™ tube, which put the three colors in stripes, one color next to the other. This resulted in more of the beams hitting the phosphors instead of the space between them (because there was less space wasted), and thus much higher brightness—it gave the company's TVs a tremendous advantage. The basic Trinitron patent has long since expired, and virtually all current sets are made with striped tubes.

A quick detour

By the way, if you're thinking that having the colors next to each other, no matter what the configuration, would produce three images that didn't quite overlap perfectly, you're absolutely right! Luckily, the human eye's ability to distinguish color changes over small distances is very limited. The result is that the eye blurs the three pictures into one full-color image. Heaven only knows what a color TV picture looks like to an eagle. Probably nothing very good. If you want to see what the picture is really made of, get right up to the face of the tube and take a look—you'll plainly see the red, green and blue stripes. The only TV sets that actually overlap color are projection sets with separate projection tubes, one for each of the three colors.

Back to our story

So, you now had the necessary elements to paint three pictures. But, how to scan the three images? At the back of the tube, in the neck, were separate "electron guns," which were just like the ones in a monochrome tube, except that there were three of them next to each other. Behind the layer of phosphors on the tube's face, a metal grille with very fine holes, called the "shadow mask," was placed. The angle of the holes permitted only the beam coming from the requisite gun to enter, so the beam for the green image could only light up green phosphors, and so on. Now, it really was possible to paint three colors at the same time, all independently. But from where was the color signal to come?

Sooo-eeee!

Talk about a bandwidth hog! It was possible to simply transmit three complete TV signals, use three tuners at the set, and be done with it. Possible, yes. Practical, no. First of all, such a scheme would require using up three times the spectrum space of a monochrome signal. Second, it would require three times the transmitter power. Third, three tuners in each set would be mighty expensive. Finally, doing it that way would make the signals incompatible with the millions of existing monochrome sets. Why? Because the mono set would only be seeing a picture whose brightness values corresponded to one color out of three. It would be recognizable, but it would sure look weird.

Another approach

There had to be another way, and there was! Inventing it meant thinking of a color picture in a completely different way: as two separate elements. One was the brightness of each dot on the screen, which was exactly the same as with any monochrome picture. The second was the color value of that dot, which itself consisted of two more elements: hue (such as red, orange, etc.) and saturation (how strong the color was).

The advantage of treating the picture that way, instead of as three separate images, was tremendous. Now it was reasonable to consider sending the image in about the same bandwidth as a monochrome picture. Remember when I said that the eye can't discern fine spatial details of color? Well, that meant you didn't need to send very detailed color information, so the color (or "chroma") signal didn't require a lot of bandwidth, as long as the brightness (or "luminance") bandwidth was high.

Piggyback

But where, oh where, could you put the chroma signal? The answer lay in a bit of spectral cleverness. Television, being a repeating phenomenon—each line repeats at the same rate, no matter what's in the picture—had most of its spectral energy in repeating clumps of frequencies, with very little energy in between them. It was decided that a subcarrier signal (a carrier riding on the luminance signal) could carry the color information. By carefully choosing the frequency of the subcarrier so that it didn't divide evenly into the line rate, the spectral holes could be filled with the color signal. In theory, the two wouldn't interfere with each other!

In theory. In practice, if a signal is there, it's there, and you'll see it. Due to the deliberate nouharmonic nature of the chroma vs. line rate frequencies, the real effect was that each line of video had most of the chroma peaks and valleys in different places, and each frame had them opposite to the last one. The result was that the color signal appeared as a slight herringbone pattern, hard to see because it tended to average out over two frames. If you want to see what it looks like, get a black-and-white TV with a manually adjustable tuner, and turn the fine-tuning control in the direction of maximum picture sharpness (usually clockwise). Keep turning it a little more, and you'll see the herringbone pattern. You may also see squiggly lines that move with the audio portion of the broadcast, because another subcarrier carries the sound, using FM.

Exactly how the color information for the entire visual spectrum is encoded onto one subcarrier is a fascinating topic, and we'll explore it next time. Until then, 73 de KB1UM.

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Visiting local schools

It's always nice learning about what hams are doing throughout the country to help promote amateur radio to young people. It's important to share ideas with each other so we can all benefit from the successes we've been fortunate enough to achieve. My friend Bob Raffaele W2XM from Albany, New York, has always been interested in getting children involved with the hobby. He recently sent me the following article he wrote in hope that readers of this column would get some ideas that they could use in their local schools.

Bob writes: "Most of us get so much satisfaction from ham radio that we want to share it with those who are not yet involved. For those who want to make a presentation to school-aged kids, I hope this encourages you. School kids are curious and quick to learn. However, there are obstacles. In general, kids are more than a little impatient and undoubtedly hard to impress. I've dealt mostly with 6th graders. They know about cellular phones and the World Wide Web; they will not be awed by a demonstration of your HT and a description of the DX you can work from home.

"Hams communicate via keyboard and CRT, voice, telegraphy, and television. They talk with astronauts, DXpeditioners, and fellow hobbyists of all ages. Hams are pioneers in communications technology; they assist in emergencies; and many have rigs, and HF or packet stations, right in their cars. To help children to appreciate our world of amateur radio, we'd like to teach them about all these things... and more.

"In our enthusiasm, however, we sometimes have a tendency to cause kids to expect more than we can deliver at the moment. Let's not build up their expectations, only to let them down. There is no sadder sight than a classroom full of disappointed middle-schoolers. Playing it safe, this presenter uses 40 SSB, 15 SSB, and 2m FM for most live demonstrations. On-the-air QSOs are only a small part of a comprehensive lesson on ham radio.

"Nathaniel KB2HPX and I have planned a presentation that fills two to three hours on each of two days. I've adapted this lesson for 6th graders because at this grade level they know enough geography and math skills to benefit from the interactive learning."

Bob goes on to explain that since he and Nathaniel teamed up to do their presentations in local schools in 1992, they've been very well received. But recently the demand for them in the classroom has decreased. They seem to have met up with what many of us in the classroom are starting to encounter... the inevitable comparison to the very popular Internet.

We who are concerned about the recruitment of young people into ham radio need to be ready to change our old motivation techniques when they really don't work like they used to.

Bob continues: "On-line access to information and pictures, and the ability to transfer large quantities of data quickly and reliably, are aspects of communications where the Internet beats amateur radio hands down (as long as electrical power and telephone service are available and uninterrupted). The Internet is an appliance; many people use it, but few understand it. Ham radio is a communications service and an educational hobby that can be so totally engrossing it can easily become a 'way of life.'

"Perhaps an environment in which both newcomers and veterans are being enriched and in which technology is being advanced should be called a very successful educational institution, and not just a 'hobby.'

"Here's a lesson that works well in a classroom and includes operating a low-band rig. Forty meters and 15 meters are the bands of choice. The antenna is a 40m dipole, modified to enhance dual-band operation.

"With hand-held rigs, small antennas, repeaters allowing distant contacts, autopatches, and local hams standing by to encourage the kids, a 2-meter contact can be great. Our VHF antenna is a vertically-mounted coaxial dipole that is placed outside. The antennas should be installed and tested before the demonstration.

"Kids will be intrigued to find you talking on the air as they enter the classroom that day. Using this 'teaser' as an introduction is a good idea only if the demonstrator is not performing solo. Someone has to explain what is happening.

"It is explained that the only things required for the exchange of voices are invisible radio waves and devices to emit and capture them. A display of antennas can be set up so the students can see that ham antennas need not be expensive or large and cumbersome.

"Students can calculate the lengths of the antennas with the help of formulae that you provide. You can teach the meaning of 'frequency' as being a 'location on the dial.' Once 'frequency' is in their vocabulary, the kids are ready for some algebra and division: Let the math begin!"

W2XM has learned to work with the teacher to include amateur radio in other curriculum areas. Any reader who wants lesson plans to use in different subject areas can write to this "Hams With Class" column or to Bob Raffaele at E-mail: bobw2xm @tu.albany.ny.us.

Bob and Nathaniel have learned to use QSL cards and the "Archie" comic book published by the ARRL in their presentation. They seem to have mastered the importance of doing lively demonstrations, keeping the pace fast, and having lots of visual materials for the children.

Bob has so many good ideas to share about his experiences in the classroom. We wish him continued success as he continues to persevere in trying to reach youngsters in local schools.

Bill Brown WB8ELK
139 Angela Dr. Apt. B
Madison AL 35738

California balloonin'

During a recent visit with Mike Henkoski KC6CCC in San Clemente, California, I had the opportunity to participate in a unique experiment. Mike had designed an FM ATV transmitter and amplifier for the 2 GHz band. Now he wanted to use a high altitude balloon flight to test out the range of his 1-watt transmitter in combination with his latest ground station configuration. Back in November he had flown just such a transmitter onboard a rocket that sent it up to 53 miles high above the Black Rock Desert in Nevada with phenomenal results (watch future columns for the story).

The payload

Mike's payload was a very lightweight Styrofoam™ package (2 pounds total) consisting of a small exciter board on 2.442 GHz, a 1-watt amplifier, a homebrew circular patch antenna on the bottom of the package and a color TV camera (Computar pinhole). Four D-size lithium cells [made by SAFT, available from Avex Electronics (800) 345-1295] provided power for the system to give him nearly seven hours of operating time. *Note: The 2 GHz transmitter and amplifier are products designed for commercial surveillance and retuned for the amateur band. For more information on these products, check out their Web site at: http://microtekelectronics.com.*

"As the wind gusted, Lisa nearly went for a ride!"

The ground station

The receive setup consisted of a 60-inch satellite dish originally designed for the Ku band [KTI brand with an F/D of 0.41, available from Skyvision (800) 543-3025]. Mike mounted a Microtek 2 GHz receiver board on the dish along with a Tecom dual-patch circularly-polarized antenna located in its focal point, designed to slightly underilluminate it.

Photo B. Lisa Taylor prepares to launch the balloon from a park near San Clemente.

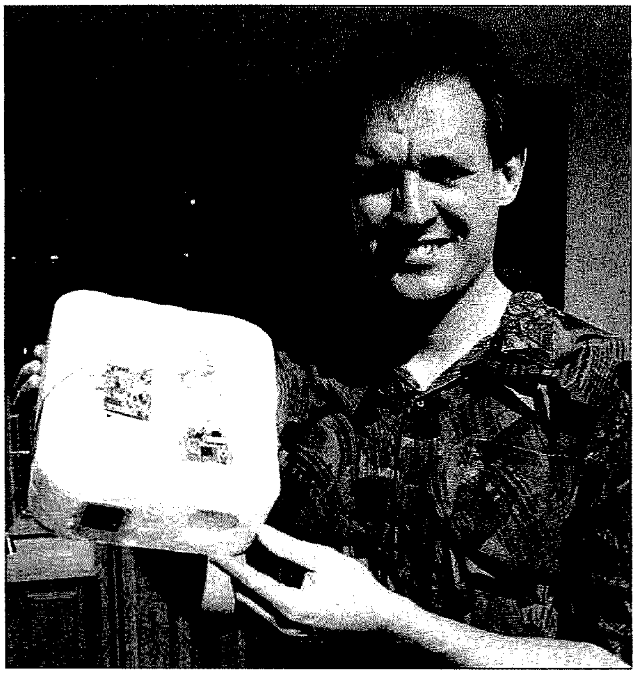


***Photo A.** (All photos by Bill Brown WB8ELK.) Mike Henkoski KC6CCC holds the 2 GHz ATV payload. The exciter board, color camera and patch antenna can be seen.*

The flight

February 1st turned out to be a typical sunny California day just perfect for launching a balloon. Mike KC6CCC, Duane Snipes WB6GGF, Bill WB8ELK and Lisa Taylor set out for a park just east of Mike's house to set up the ground station. In addition to the 60-inch dish sitting next to Mike's truck, we were able to link the launch (as well as the received downlink from the balloon during the flight) to the KC6CCC ATV repeater on top of Santiago Peak. This unique all-microwave repeater operates with an input on 10.4 GHz and an output on 3.480 GHz and will be a subject for a future column. Mike linked the launch activities up to the repeater via a special link receiver on 2.418 GHz. To cover the majority of ATVers in the region, one of the local ATVers took the output of Mike's repeater and retransmitted it out via the WA6SVT ATV repeater (also located on Santiago Peak with a 434 input and 1253.25 output). The flight coverage would involve two ATV repeaters and four frequency bands!

As Mike and Duane set up the ground station and tested the links to the ATV repeaters, Jim Porep KC6TFV and Curt Toumanian N6TWB (our chase crew) arrived on the scene. We started the balloon inflation and final checkout of the payload. Just before liftoff, Lisa (holding the balloon) nearly went for a ride herself as a couple of wind gusts kicked up. Fortunately, things quieted down and the balloon took off nicely without her.

Photo C. (l to r): Mike KC6CCC adjusts the receive dish while Duane WB6GGF and Lisa watch the downlinked video.

Although the package was spinning around quite a bit (Dramamine will be in our travel kit next time), the transmissions from the balloon were snow-free most of the time and in beautiful color. As the balloon gained altitude, we could see the California coastline from San Diego to Malibu, as well as several islands, including Catalina. Just before the balloon burst at an altitude of around 95,000 feet, we could clearly see the blackness of space and the curvature of the Earth. We could see a large portion of southern California extending from Malibu all the way to the Salton Sea. Even though the payload was well over 50 miles away, the reception was still snow-free a good deal of the time, with some deep fades. Although the large dish had a narrow beamwidth, it was possible to bring in a great picture most of the time.

When the balloon burst, we could see the package flip over and saw bits of the balloon fly past the camera. The parachute descent was smooth and we were all amazed at just how low on the horizon we could still see decent video. Apparently the signal was "knife-edging" over a nearby range of mountains, and we could see a snowcapped mountain and a small town below the payload just before it landed.

Using cross-bearings from the launch site, Mike WA6SVT's QTH, and the chase crew, we determined that the payload had landed in a particularly rugged area just east of Santa Rosa Mountain, about 10 miles south of the town of Anza. Unfortunately, it has not been recovered as of this writing.

Although the payload was lost, the flight was certainly a successful demonstration of the capabilities of microwave FM TV.

Photo D. (l to r): Jim KC6TFV and Curt N6TWB prepare to chase the payload with their mobile 2 GHz ATV receive station.

NEVER SAY DIE

Continued from page 47

mountain climbing
music: reading music
music: playing an instrument
music: familiarity with classics
music: familiarity with opera/operettas
orienteering
parachuting
photography
ping pong
poetry
printing
public speaking
rallying
repairing household stuff
rollerskating/blading
running
scuba diving
sculpting
sewing
skiing
skydiving
snowboarding
soldering
speed-reading
spelling
spelunking
surveying
swimming
tennis
tree pruning
tumbling
typing
ultra-light flying
video making & editing
water-skiing
welding
whittling
woodworking
wrestling
writing

The Sudbury Valley School doesn't have the equipment needed for kids to learn most of the above skills, so they encourage the kids to apprentice out to learn. As there are more schools like this my sneaky plan for setting up mobile laboratories which could make the equipment and teachers available to a number of schools would be practical.

Kids interested in learning about woodworking could sign up to use the equipment in the woodworking trailer when it's parked for a week or so at the school. Ditto other skills

Continued on page 61

QRP

Number 60 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

April showers bring May flowers, but they also bring the Dayton Hamvention®! This year, the QRP forums will be larger than ever. Last year, we completely filled the banquet room on Saturday night!

Here's this year's information directly from the source, Bob Gobrick VO1DRB/WA6ERB, FDIM Publicity Chairperson:

Four Days In May QRP Symposium—the amateur radio QRP event of 1997

The QRP Amateur Radio Club, International (QRP-ARCI) proudly announces the second annual Four Days In May QRP Symposium to be held on Thursday, May 15, 1997—the first of the four festive days of 1997 Dayton hamvention QRP activities. Mark your calendar for this extra bonus day and register early for this not-to-be-missed QRP event of the year.

Amateur radio QRP presentations, workshops and demonstrations will be the focus of the full-day Thursday activities to be held at the Days Inn Dayton South (513-847-8422). Last year, this sold-out event had a "standing-room-only" crowd of 100 enthusiastic pre-registered attendees. For 1997, the FDIM QRP Symposium will be moved to the hotel's larger ballroom facility, so make your reservations early before it is sold out again. FDIM QRP Symposium attendees will start their day with a wake-up coffee social and then plunge into a morning of multimedia QRP presentations by renowned QRP authors and designers. At midday, attendees are treated to a catered lunch and QRP door prizes. Then it is back to an afternoon of exciting QRP technical presentations. Topping off this first day will be an evening of guest QRP tutorials sponsored by regional QRP clubs. The 1997 Four Days In May QRP Symposium will be the talk of the 1997 Dayton hamvention.

The Four Days in May QRP extravaganza then continues with the annual Friday night QRP-ARCI Awards Banquet honoring QRP dignitaries for their service to the amateur radio community. Following the awards banquet, a special evening has been set aside for the FDIM QRP Vendor Social where prizes will be drawn. Saturday will also be special this year with an evening for QRPers to meet the many regional North American and international QRP clubs—bring your banners! QRP Club awards will be presented to those who submit their pride-and-joy QRP construction projects for judging.

> **"Last year, this sold-out event had a 'standing-room-only' crowd of 100 enthusiastic QRPers."**

Four Days In May QRP Symposium: frequently asked questions

• QRP Symposium Presenters—Please submit your QRP technical manuscripts to FDIM Technical Paper Chairperson Bruce Muscolino W6TOY/3 at P.O. Box 9333, Silver Spring MD 20916-9333; E-mail: w6toy@erols.com. Presenters' papers will be bound into the 1997 FDIM QRP Symposium *Proceedings*. All attendees receive the *Proceedings*.

• FDIM QRP Symposium Registration Fee—Registration for the Thursday, May 15, 1997, FDIM QRP Symposium will be $30 if prepaid by May 1, 1997, and $35 after that date or at the door. At the door, registration may be limited if we once again sell out. Please register early to guarantee a seat. Registration will cover a full day of QRP Symposium activities, which include the QRP technical presentations, the 1997 FDIM QRP Symposium *Proceedings*, the scrumptious QRP luncheon, those famous "special" Symposium bag stuffers and, finally, an endless QRO coffeepot.

Please send your $30 registration fee (US check, money order, or international money order) made out to "Bob Follett" by May 1, 1997, to: Bob Follett AB7ST, FDIM Registration Chairperson, 2861 Estates Dr., Park City UT 84060. E-mail: bfollett@ditell.com.

• QRP-ARCI Awards Banquet—This not-to-be-missed Friday, May 16, 1997, event is once again being hosted by FDIM Banquet Chairperson Pete Meier WK8S. Please send your $15 banquet ticket fee (US check, money order, international money order) made out to "Pete Meier" by May 1, 1997, to: Pete Meier WK8S, 4181 Rural, Waterford MI 48329. E-mail: pmeier@tir.com.

• FDIM QRP Vendor Social—A tradition was started at FDIM 1996—a special evening was established to officially introduce our QRP vendors from around the world. All are invited to attend this wonderful Friday, May 16, 1997, evening social. Preston Douglas WJ2V will once again be our gracious host. QRP vendors: For registration information, please contact Preston Douglas WJ2V, QRP Vendor Evening Chairperson, 216 Harbor View N., Lawrence NY 11559. E-mail: pdouglas12@aol.com.

Bob Gobrick concludes: "On behalf of the entire FDIM team, I invite you all to join us for the QRP event of 1997—the Four Days In May QRP Symposium at the 1997 Dayton hamvention. Questions? My E-mail is 70466.1405@compuserve.com. See you all there!"

So there you have it—all the information you need to join us next month. I highly recommend the Four Days in May for all QRP operators. And don't forget: While you are enjoying the Four Days in May, your wife can be off happily shopping at the Dayton Mall. It's within walking distance of Days Inn South!

Rooms for Dayton

As in the past, Myron is handling the rooms for the hamvention. You can contact Myron at (330) 477-5717 to inquire about the status of open rooms. There is usually a waiting list, so don't wait too long.

QRP-ARCI dues

One more time, just in case you missed it: The cost of joining the QRP-ARCI is $17 for US hams. To renew your membership, the price is $15 for US hams. New membership for Canadian hams is $20; renewals, $18. DX members: the price of new membership is $27; renewals, $25. Remember, though, that these prices include air mail delivery of *The QRP Quarterly*. Send your renewal or new membership request to me at P.O. Box 508, Massillon OH 44648.

There are no special forms to fill out. All I need is your check or money order and your address. Watch your handwriting, though, please: make Us and Vs look like what they are supposed to be.

If you were a member years ago, be sure you let me know. If you don't, you'll get a new membership number. So if you joined the club in 1972, please include your old QRP-ARCI number. Remember, you are a member for life in the QRP-ARCI.

Net worthy

Much to the displeasure of my wife, I keep way too much paper lying around the house. So, to prevent drowning in any more, I've started to surf the World Wide Web in my search for technical data.

If I'm looking for datasheets on semiconductors, I start by pointing my Web browser at Harris Semiconductor. They are at: www.semi.harris.com.

Looking for a special-purpose IC? How about a battery charger chip for your latest QRP rig? Then by all means check out Maxim products. They specialize in portable (low current) ICs and are on the World Wide Web at: www.maxim-ic.com.

Micrel Semiconductor also has its own Web page. They are located at www.micrel.com. Micrel handles low drop out regulators, power supply control chips, and power MOSFET drivers.

Need something from Texas Instruments? Then check 'em out at www.ti.com. On the other hand, if you have no idea where to find that special or unusual part, then a peek at the *EITD* online (the *Electronic Industry Telephone Directory*), with its 30,000 listings, is a must. *EITD* is hiding with *Electronic Component News* at: www.ecnmag.com/eitd.

"That shoots my 'paperless' shack in the butt, doesn't it?"

Most of the Web sites have the datasheets for every part that the specific company makes. You can usually view these datasheets online. However, I like to download them for later use. If you do, you should know that the datasheets are stored in different formats.

By far the easiest to use is Adobe Acrobat. It's free and easily obtained at a zillion sites on the Web. Most of the time, you can get a copy at the same time you download the data files. The best part about Adobe Acrobat is its ability to download a datasheet from the Web for use on either Macintosh-format or Wintel machines. Of course, Adobe Acrobat allows you to print out datasheets, too, if you desire. Then again, that shoots my "paperless shack" in the butt, doesn't it?

Next month

I have a special project for you the next time we meet. I'm not going to tell you that you won't be able to live without this, but it is a lot of fun to build and really does something useful. As a matter of fact, it's not so much a project to build as it is a learning experience...

Until next month, see you at Dayton Hamvention 97!

NEVER SAY DIE

Continued from page 59

requiring specialized equipment and teachers.

In God's Image

Hmm, here goes Wayne again, stirring up the religiously inspired. The ARRL is absolutely right, amateurs should not discuss religion or politics, because in these areas belief is stronger than reason. Indeed, belief is so strong that many people can't tell it from reason, so any attempt at reasoning just makes them angry.

Well, that's never stopped me from upsetting people before, so why should I start now?

The *Bible* says man is made in God's image. Naturally women have a bone to pick over this. Maybe a rib. But since every person is different, I don't understand the "image" concept. Are we talking a Japanese Sumo wrestler? A Hottentot? Liberace? Tom Thumb? Are we talking a one-month-old zygote or a 120-year-old woman?

The people who die and go to heaven, and then come back (NDEs), are consistent in reporting that there is a God, though for some strange reason they seem to lose any interest they'd previously had in the organized religions. None of their reports mention anything about God being in man's image. Or woman's.

Well, we've made an enormous amount of scientific progress in the last hundred years, but little spiritual. Most of our major religions are based on ideas 1,500, 2,000, 2,500, and more years old—ideas expressed in the *Bible*, the *Koran*, the *Talmud*, the *Baghavad-Gita*, the *Vedas*, and so on. I've been reading some very interesting books about how these ideas developed, but I'm sure that devout believers in any of these sacred texts would get very upset from reading about their history.

Okay, so stone me as a heretic. My ancestors were thrown out of Scotland for being religious nuts. They moved to Ireland, becoming the Scotch-Irish. The Irish put up with their baloney for a while and then they, too, threw them out. So they came to America.

How does God handle the billions of other solar systems in our galaxy? And the billions more solar systems in the billions of other galaxies? Did God have a father? If not, where did God come from? Everything has to have a beginning. If there really was a big bang (and the more you look into that whole idea, the less water it holds), was God there before it? So what was God busy doing before there was a universe?

If our universe is expanding, what's it expanding into? Is Earth expanding too? If the universe is expanding, wouldn't Earth have to also be expanding, right along with it?

Now I can see why I should write about DXing instead of religion.

Von Däniken. Again!

Yes, I know, you're a whole lot more interested in who won the last ARRL Directors' election than reading or even thinking about the Sphinx. After all, the professional Egyptologists already know everything there is to know about the Sphinx, right? And the pyramids, too.

Well, having visited the Sphinx a couple of times, and having read more and more about it recently, I no longer trust the opinions of the professional Egyptologists as to its age.

Erich von Däniken's latest book, *The Eyes of the Sphinx*, is a fun read about ancient history. And it's very well documented. He demolishes the experts (a.k.a. prestigious scientists) on the Sphinx and the pyramids.

For instance, none of the experts have come up with a reasonable explanation of how the pyramids could have been built. Von Däniken discusses all of the proposed theories, and destroys them. He cites the theory of Professor Davidovits, an archeological expert, who says the giant stones were not quarried miles away and brought to the site, but were poured, just like concrete. A set of hieroglyphs found in 1889 described the manufacture of the concrete, listing 29 minerals (and where they could be found) and several natural chemicals as the ingredients. When Professor Davidovits mixed up a batch of this cement according to the old recipe, he got a harder concrete which dried faster than modern concrete and was much more

Continued on page 63

Number 62 on your Feedback card

Carr's Corner

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041
E-mail: carrjj@aol.com

Depending on when you read this, the annual science fair season is either in full swing or just completed. Every year, in most localities, there is a round of science fairs that progresses from the school level to an area fair, to a regional or state fair, up to the international fair. At each level there is a sorting-out process in which some students are selected to go forward and others are not (we never say "lose" because that's not the issue). I usually judge three to six fairs depending on my available time. This year, I did not do as many as in the past because I teach Visual BASIC (a computer language) on Saturday mornings at our local community college.

If you have any technical ability, or if you are trained in any of the sciences or mathematics, then I recommend that you get involved in science fair judging. It's really rewarding to see kids who work in a disciplined manner to ferret out some bit of truth about Nature. While few of them will ever earn a Nobel Prize, or even take up science as a career, there is a distinct learning process going on. Students who negotiate the rigors of even high school science learn to think critically, and to organize facts and data.

Science fairs are not only personally rewarding, but they can also steer youngsters into amateur radio. Perhaps your local club ought to sponsor a special prize, a scholarship, or even just a certificate for the "best of fair." It would certainly get some publicity for the hobby. It would especially be useful if the prize is restricted to students who do something related to radio, or who are amateur radio operators, or something else that is relevant. Most science fairs have a time for special judging by professional societies and other interested groups. The local fair coordinator can get you the information.

If you are a high school student, or have a high schooler in your household, or know and mentor (Elmer?) a student, then you might want to copy the material below and put it to good use.

Winning a science fair

Science fairs are about science, so scientific method counts for a great deal. When I wrote about this subject one time before, a reader (of a different magazine) wrote me a harsh letter and complained that a young friend had been rejected at a science fair because she did not have a stated hypothesis. The claim was made for her that the project was a perfectly valid environmental project and was based on good data. It probably was, but if it doesn't have some hypothesis at risk, then it is doubtful science at best.

"If it doesn't have some hypothesis at risk, then it is doubtful science at best."

A hypothesis is a falsifiable statement of what you are looking for. The term "falsifiable" means that it is capable of being proven false. Indeed, it is often easier to falsify a null hypothesis, i.e., the statement that something cannot occur, than it is to falsify the hypothesis itself. Here's one example. Suppose the hypothesis is that "All cats are gray in color." You can inspect 10,000 gray cats and still not be sure that all cats are gray. Even a single not-gray cat disproves the hypothesis. The example is trivial, and a bit weak, but you get the idea.

Another example—but please, please, please don't try this experiment at home. Suppose the hypothesis is: "Kerosene in an open dish cannot be ignited by tossing a lighted match into it." You can toss a thousand matches into it and see them doused without knowing for sure that the hypothesis is correct. But, if you rephrase the question to: "Kerosene in an open dish can be ignited by a lighted match," a different situation is found. If a single match lights off the kerosene, then the original hypothesis ("cannot") is falsified.

The hypothesis should be written out before the experiment is designed and conducted. Furthermore, when planning the experiment, decide what data constitutes sufficient proof of the hypothesis and null hypothesis. If data collection involves some ambiguity, make a prior decision on how to count each datum. For example, if the relevant data are temperatures, and you classify "above 100 degrees" and "below 100 degrees," then specify beforehand where readings of exactly 100 degrees will go. Some people will place all of the exact readings in one class or another, while others alternate back and forth (i.e., the first 100 degree reading goes in one class, the next in the opposite class). Still others randomly assign the data point to one class or the other.

Do enough trials of the experiment to ensure that the results are significant. Doing three or four trials is probably not sufficient. Perhaps 20 or 30 is better. No one expects high school students to have the resources and time to do some more complex experiments with the number of repetitions that statisticians would like—or that professional scientists would use—but "only a few" is clearly suspect.

It is also critical to do your own work. While that should go without saying, there are always those who have someone else do the work and submit it as their own. Sighhh. Of course, sometimes judges make errors. I recall one youngster, whom I knew personally, who built an electronic project too well. Some judges claimed that he had to have had his father do it for him, because the quality of construction was too good. But I knew the kid had done a lot of projects other than the science fair project, so I intervened and convinced them that his father did not do it. Indeed, he probably didn't know how—he was an accountant with no amateur radio or hobbyist electronics background. The kid's project might as well have been in Greek for all his father knew about it (same with the boy's mother).

Another good trick is to keep a complete notebook on the project. Professional scientific or engineering notebooks are available, but are too costly for most high school projecteers. The standard in science is to use a bound notebook so that other people can tell if pages—perhaps *embarrassing* pages—were removed. One of those speckled black and white "composition notebooks" is just fine at the high school level.

Make all entries in the notebook in ink. Do not attempt to erase erroneous entries. Cross them out, in ink, note the date of the correction, and place your initials by the correction. Close to the same spot write in the correct data, if available.

Make good use of statistics. If you don't know anything about statistics, then get an introductory book. I can immodestly recommend my own book: *The Art of Science*. It has a lot of very good information for the budding scientist, and is well within the intellectual reach of even average high school students. That old bromide about "you can prove anything with statistics," meaning that you can propagate rubbish, or "there are liars, damn liars and statistics," is essentially hogwash. There is only good use of statistics and bad use.

Also, learn what "significant figures" means. If you measure a potential of 1 volt and a current of 3 amperes with the usual measuring instruments, the answer $R = E/I = 1/3$ is not "0.333333333" (or however many digits your calculator can carry), but "0.33" or "0.333" at most; in some cases, it might even be "0.3." The judges are not only not impressed with such seeming precision as "0.333333333," but might be sufficiently *un*impressed to count off significant points for such sloppiness.

The display that you prepare should be as nice as possible. If you have the resources, use your

computer graphics and word processor programs. Mount everything on foam-backed poster paper (or even use one of those three-panel "science fair" displays made from foam-backed poster paper). If you don't have the resources, then hand write—or print—everything as neatly as humanly possible. Judges are generally not impressed enough with the display to award a higher place for bad science, or reduce the place for good science, but in borderline cases the display can make the difference. And if you are good enough to go to the regional or state science fair appearance becomes a lot more significant. At that level, all of the competition is good.

Above all, know your subject and be prepared to answer some questions. If you don't know the answer, then don't try to scam the judge—it won't work. "I don't know" is an acceptable answer if it is the truth, especially when followed by "...but I intend to find out." The essence of good science is the Confession of Ignorance, coupled with the integrity to admit it out loud, and the energy to go find the answer. After all, the professional scientist spends most of his or her time out on the frontiers of knowledge, and out there Nature is very unforgiving of a "know-it-all" attitude. *"Y gwin erbyn y byd"* ("Truth prevails against the whole world"), the war cry of the Iceni (Briton) Queen Boudicca (ca. AD 61) applies to science—but only for those who have the integrity to seek it out.

New book for computer types

If you are into programming or building computers, whether for control of amateur radio, some other practical project, or just for yuks, then there is a book that you need to see. Have you noticed all those accessories that work off the parallel printer port? There's a gazillion of them. Ever wondered how they do that trick, and how you could do it? Then take a look at *Parallel Port Complete* by Jan Axelson. It contains the hardware and software details for programming and interfacing to the parallel port. I've got a copy to review, and it looks great! It can be bought for $39.95 (includes Visual BASIC diskette), and is available from Lakeview Research, 2209 Winnebago Street, Madison WI 53704; phone: (608) 241-5824; FAX (608) 241-5848; E-mail jaxelson@lvr.com. The cover image and additional information can be found at Web site http://www.lvr.com/ppcpress/htm.

NEVER SAY DIE

Continued from page 61

resistant to environmental factors. It wasn't long before a French company started making concrete using this old recipe, and Lone Star has introduced the harder, faster-drying mix in the U.S.

A microscopic examination of a rock sample from the Great Pyramid by Davidovits turned up traces of human hairs.

You can see why I found the book so fascinating. It's published by Berkley Books, ISBN 0-425-15130-1, 278pp, $12.

Von Däniken makes a good case for the Sphinx being up to 10,000 years older than believed by the experts, and the same for the Giza pyramids. The experts disagree, mainly because they say that the technology required to build these enormous structures was impossible that early.

Encouraged and excited by this book, I next tackled Zacharia Sitchin's *When Time Began*. This Avon pocket book runs 410pp, ISBN 0-380-77071-7, and costs only $7. I've got four of Sitchin's books to read. He's done an amazing amount of research in archeology and ancient texts and his books are thoroughly illustrated with these references, so his interpretations of history seem well founded. Interesting stuff, and not what you're taught in school.

It is upsetting to Egyptian historians to admit that the major Egyptian monuments predate Egyptian civilization and thus have to be the product of some other people. Or maybe non-people (aliens).

Oh well, I'm sure that there's no possible connection between endless ancient texts about aliens and the current spate of abduction reports, UFO sightings, the shadowy figures behind the Fed, the Council of Foreign Relations, the Bilderbergs, the Illuminati, and so on. That's all the usual conspiracy hokum. No, let's ignore all that nonsense and worry about the sunspot cycle and when our HF bands are going to come back to life.

Weird Forces

Von Däniken, in his new Sphinx book, explains how the "pyramid effect" was discovered by Antoine Bovis in the 1930s. This is the strange effect which

Continued on page 81

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

How to Generate $1 Million In Extra Sales.

In this video Wayne explains how almost any company can generate lots more sales using PR instead of advertising. Learn the secrets of how to write and get your PR releases published. Learn how to get product reviews which are pure gold for sales. Not one company in the ham industry is taking full advantage of the power of PR. This is something most ad agencies know little about. The video is a paltry $39.95.

World's Fastest Code Course

The old, hard way, to learn the code is to start slow and gradually speed up. In that direction lies madness. The Blitz Method is to start at 13 or 20 wpm immediately. Yes, tapes are available to help. Use T-5 to learn the characters. T-13 will get your General ticket with a few hours work. T-20 ditto for Extra. The tapes are $7 each and are as nasty as Wayne could make them.

Cold Fusion Journal

Try a 12-issue subscription for $50. This is going to be one of the largest industries in the world in a few years, and the ground floor is still open.

Number 64 on your Feedback card

Communications Simplified, Part 16

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

So far we've covered a few of the basic antenna types—the dipole, 1/4-wave vertical, and the yagi beam. Let's look at some more general concepts.

Types of feedline

When an antenna consists of two identical parts, such as the two halves of a dipole or the driven element in a yagi, it can be fed by a balanced line. The two sides of the antenna get equal, but opposite, voltages. For low-power applications, 300-ohm twinlead could be used, but for higher powers, or if line losses are important, an open-wire line is more common. This consists of two conductors, kept apart by insulated spacers every few inches. These spacers have less loss than the continuous strip of plastic used in the twinlead.

But when the antenna consists of unlike parts, such as a vertical antenna and its ground plane, you should use an unbalanced line, such as a coax cable. You can mix and match by using a balun to match a balanced load to an unbalanced line, or vice versa. With a transmitting antenna, however, you must be sure that the balun can handle the power. The balun can be a transformer, as discussed in our transmission line chapter, or it can be made from coax cable.

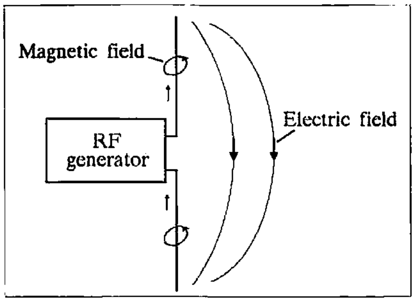


Fig. 1. Fields around a dipole.

People sometimes use a coax cable to feed a dipole; although this works, it greatly distorts the pattern of the antenna, because the coax shield now becomes part of the antenna, and itself radiates.

"There is one concept, often forgotten, that is crucial to success."

The counterpoise

In the electric and magnetic fields of **Fig. 1**, we specifically refer to a dipole, and we show the electric field extending from one end of the dipole to the other. A similar thing occurs with a vertical antenna, except that this time the electric field extends from the top of the vertical whip down to the ground plane under it, as shown in **Fig. 2**. In other words, the ground plane (and the coax shield it connects to) is an integral part of the antenna.

In general, any antenna that directly generates an electric field needs two parts between which the field can extend. If only one part of the antenna is up in the air, then the other part has to be down at the bottom somewhere, so it can act "against" the top part. It is therefore often called the counterpoise.

This is a concept often forgotten by amateur antenna builders, but it is crucial to success. If an antenna does not supply its own counterpoise (such as the other half of a dipole, for example), then an external counterpoise (usually grounded) must be provided.

Loop antennas

Two paragraphs ago, we used the phrase "any antenna that directly generates an electric field." There *are* antennas that do not.

We mentioned that radio waves consist of an electromagnetic field, which is a combination of an electric field and a magnetic field. There are antennas which generate (or detect) mainly the magnetic field; they let the buildup and collapse of the magnetic field generate the electric field which is ultimately necessary to transmit the signal through the air.

A simple example is the loopstick antenna used in almost all AM broadcast receivers. It is simply a short rod of ferrite (an insulating rod which contains metal powder), with a coil wound around it. As the magnetic component of the electromagnetic field passes through it, the coil generates a voltage. The advantage of such an antenna is that it can be quite small—even though a half wavelength at the AM broadcast band is on the order of 1,000 feet or so, the

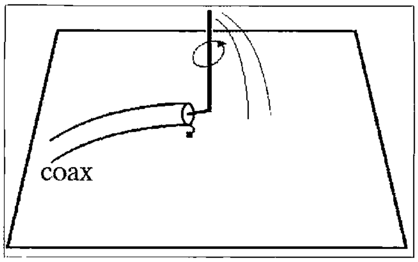


Fig. 2. Fields at a vertical antenna.

loopstick antenna is usually just a few inches long.

There are also several models of commercial loop transmitting antennas. They are not as efficient as some other antennas, but they feature small size. For example, a dipole antenna for the 20-meter (14 MHz) amateur band would be about 34 feet long; a loop antenna for that band is less than one tenth that size.

Collinear antennas

In introducing directional antennas, we discussed using multiple radiators whose signals add in some directions, and cancel in others. Our prior examples used radiators which were parallel to each other; these radiators could also be placed end to end, in which case the antenna is called a collinear antenna, because all the radiators are on the same line.

A common example consists of two or three vertical dipoles, placed one above the other. A receiver at the same height as the collinear transmitting antenna will get the sum of the dipoles' signals, but the signals heading for a receiver at a slightly higher or lower altitude will partially cancel. The effect is to take the dipole's normal vertical radiation pattern, and squeeze it. The normal radiation pattern wastes some signal by sending it down into the ground and up into the clouds; the collinear antenna reduces the radiation in those directions, and sends it out more horizontally.

Nonresonant antennas

You probably know that in a resonant circuit, the capacitive reactance and the inductive reactance are equal, and they therefore cancel. That is, a resonant circuit appears as a pure resistance because the reactance is canceled out. The antennas we've discussed so far in this chapter were resonant also; that is, their length (some multiple of a quarter wavelength) made them appear as a pure resistance load.

DETOUR

When you calculate the length of an antenna in wavelengths, remember to consider the speed of the signal in the antenna wire—the velocity factor. The velocity factor of a plain wire depends slightly on the diameter of the wire, but it is about 0.95, so a 1/4-wavelength antenna would be about 5% shorter than 1/4 of a wavelength in air.

END OF DETOUR

Many antennas, however, are nonresonant, or perhaps resonant at some frequency other than where we want to use them. This adds a capacitive or inductive reactance, which means that there will be some mismatch to the resistive Z_o of the line that feeds them. The common solution is to add just enough of a capacitance or inductance to the circuit to cancel out the reactance of the antenna.

"This trick is often used to shorten an antenna."

This trick is often used to shorten an antenna. For example, a 1/4-wave vertical antenna for the 27 MHz CB band would be about 102 inches long, a bit unwieldy for most mobile operators. The antenna can be shortened, but then it has a capacitive reactance. This can be canceled out with a loading coil (inductance) at the base or near the bottom of the antenna. Likewise, a 1/4-wave whip for a 2-meter amateur handie-talkie would be about 19-1/4 inches long; the antenna can be shortened but then appears capacitive. Many such radios use a rubber ducky" antenna, which winds the antenna in a coil and thus adds inductance to make it resonant.

The disadvantage is that this greatly reduces the efficiency of the antenna. Shortening an antenna by 50%, for example, reduces its efficiency by more than 50%. This doesn't matter much in most receive applications, but is important in a transmitter because the extra inductance tends to heat up and absorb power that should be transmitted.

Feed methods

So far, we've seen antennas with the feedline connected in the middle (as in the dipole or the driven element in the beam) and at the end (in the vertical antenna). Antennas can also be fed at other points, such as slightly off the middle, or at the 2/3 point. In general such antennas do not provide a resistive load, and so some extra capacitance or inductance is needed to make them a good load for the transmission line.

Modern cellular phone antennas are an interesting example of a combination of different feed methods to make a collinear antenna. Most mobile cell phone antennas look like **Fig. 3**. If we break down the antenna into its parts, we see a 1/4-wave vertical at the bottom, with a 1/2-wave antenna above it, making a collinear antenna. But the 1/2-wave antenna at the top is fed at its bottom end rather than in the middle like a dipole. A short inductor between the two antennas takes some of the signal from the bottom antenna and couples it into the top antenna.

Antenna gain

We have shown that directional antennas concentrate the power in a desired direction, and reduce the power going off in undesired directions. This implies that the directional antenna puts out a

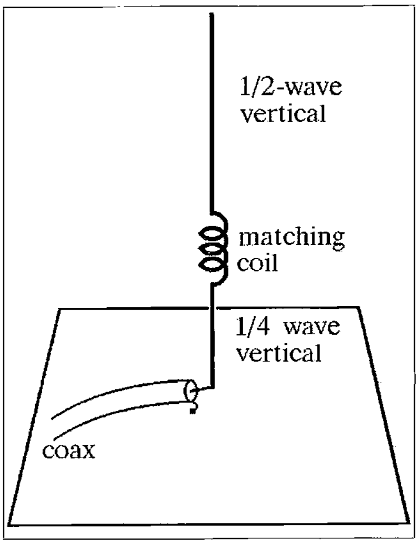


Fig. 3. A common cellular antenna.

stronger signal in its desired direction than a nondirectional antenna would. This improvement is called an antenna's gain. So if one antenna puts out a signal that is 3 dB stronger than that of a nondirectional antenna, we say that it has 3 dB gain. The catch, of course, is that we have to aim the directional antenna correctly.

Well, there is actually another catch, too. Every antenna is directional—there is no such thing as a truly nondirectional antenna, since even a simple dipole or 1/4-wave vertical transmits nothing off its ends. So to be able to do any meaningful comparisons, we have to invent a nondirectional antenna first.

Enter the isotropic antenna. This antenna is impossible to build, but it is useful to imagine it anyway. We assume that the isotropic antenna is (1) perfectly efficient, with no losses, and (2) perfectly nondirectional. All the power it gets from the transmitter is sent out into space equally in all directions.

So let's connect the isotropic antenna to a transmitter with some transmission line. If the power going into the isotropic antenna is P watts, then the Effective Radiated Power or ERP coming out of the isotropic antenna is also P watts.

The idea of ERP becomes important when we consider a directional antenna. Suppose the directional antenna aims its signal so that in some desired direction its signal is a thousand times as strong as the isotropic antenna would be. The word "effective" implies that only the power actually going toward the receiver is useful or effective, so the Effective Radiated Power of this directional antenna is then also a thousand times as large. A 1-watt transmitter feeding such an antenna would put out as strong a signal in this one desired direction as a 1,000-watt transmitter using an isotropic antenna; the 1-watt transmitter and its directional antenna would then be putting out an ERP of 1,000 watts. What this points out is that it is not a good idea to stand in front of a very directional, high-gain antenna, even if the transmitter power is fairly small, because the ERP could still be large.

Back to the isotropic antenna. Suppose we send P watts into it, to be radiated into space in all directions. Let's then build a large sphere around the antenna, and collect all the power it radiates—we should then get our P watts back. (Don't worry about how we're going to do this—this is only a theoretical exercise anyway.)

Since this is an isotropic antenna, every part of the sphere gets an equal amount of power. If the sphere has a radius of R meters (the common unit of measurement for this calculation), its surface area is $4\pi R^2$ square meters. Splitting the P watts into $4\pi R^2$ little pieces, each one square meter in size, tells us that the power hitting each and every square meter of the sphere's surface is

$$\frac{P}{4\pi R^2} \text{ watts per square meter.}$$

This number is called the power density at that distance from the antenna. More generally, since an isotropic antenna getting P watts also has an ERP of P watts, we would write this as

$$\text{power density} = \frac{\text{ERP}}{4\pi R^2} \text{ watts per meter}^2$$

"This antenna is impossible to build, but useful to imagine."

Let's try an example. The power density of a 10-watt signal being transmitted by an isotropic antenna (which has an ERP of 10 watts), calculated 1,000 meters away (about 2/3 of a mile), is

$$\text{power density} = \frac{\text{ERP}}{4\pi R^2} = \frac{10 \text{ watts}}{12{,}566{,}360 \text{ m}^2} = 7.96 \times 10^{-7}$$

which is about 0.796 microwatts per square meter.

Let's now switch to a dipole, still assuming little or no loss in the antenna itself. The same 10 watts of power is now being concentrated broadside to the dipole, with little or no power coming off the ends of it. A receiver broadside to the dipole will now get more of a signal than it got with the isotropic antenna.

Broadside to the antenna, a dipole transmits 1.64 times more power than the isotropic antenna. The dipole therefore has a gain of 1.64 over an isotropic antenna, and the ERP is now 16.4 watts. Translated into decibels, we get

$$10 \log \frac{1.64}{1} = 10 \times 0.214 = 2.14 \text{ dB},$$

so the half-wave dipole has a gain of 2.14 dB over an isotropic antenna. To remind us that the comparison is with an isotropic antenna, we write that as 2.14 dBi (i for isotropic).

Obviously, then, an antenna with high gain has to be very directional, since we never get something for nothing—what looks like gain is just the antenna aiming most of the radiated power in some preferred direction, at the expense of other directions.

Let's continue with our example. Suppose our 10-watt signal were radiated with a test antenna having a gain of 3 dB over a dipole; we say that its gain is 3 dBd (d for dipole). If the antenna has gain, then it is directional and so we must aim it toward the receiver; hence we must talk about the gain in its major lobe.

So we might then ask—what would be the power density 1,000 meters away (in the major lobe, obviously)? We already know the power density for an isotropic antenna, so we need to convert dBd to dBi. If our test antenna has a gain of 3 dBd (3 dB over a dipole), and the dipole itself has a gain of 2.14 dBi (2.14 dB over an isotropic), the test antenna has a gain of 5.14 dBi (you add the two dB ratings).

Using the standard formula for converting power gain into dB, we work it backwards to get a power gain of about 3.27:

$$5.14 \text{ dB} = 10 \log \frac{P_{test}}{P_{isotropic}}$$

$$0.514 = \log \frac{P_{test}}{P_{isotropic}}$$

$$\frac{P_{test}}{P_{isotropic}} = 10^{0.514} = 3.27.$$

In other words, the power radiated in the desired direction (the major lobe) of the antenna will be 3.27 times that produced by an isotropic radiator, and so will the power density. (And our ERP is now up to 32.7 watts.)

In our example, the power density would then be

$3.27 \times 7.96 \times 10^{-7} = 2.60$ microwatts/meter^2.

An easier way to get to this same number is to use the ERP in the numerator of the power density formula, like this:

$$\text{power density} = \frac{\text{ERP}}{4\pi R^2} = \frac{3.27 \times 10 \text{ watts}}{12{,}566{,}360 \text{ m}^2} = 2.60\ \mu\text{w/m}^2.$$

Signal strength

The above calculation gives us the power density a certain distance from the transmitting antenna. However, there are commercial signal strength meters which measure the strength of a signal not as a power density, but in units of volts per meter, and it would be useful to be able to convert from one to the other.

Just as we normally calculate power as

$$\text{Power} = \frac{V^2}{R},$$

so we can calculate the power density as

$$\text{Power density} = \frac{\text{field strength}^2}{R}.$$

But what is R? R is the resistance that the signal goes through in space. Say that again?

This is another concept that requires some more advanced physics. Let's just say that free space (really vacuum, but air is similar enough) has a *characteristic wave impedance* which, for all intents and purposes, is like the resistance R in an electric circuit; its value is 377 ohms.

In this equation, the power density is measured in watts per square meter, while the field strength is measured in volts per meter. To go from a power density to field strength, we have to rearrange the equation to:

$$\text{Field strength} = \sqrt{\text{Power density} \times 377 \text{ ohms}}.$$

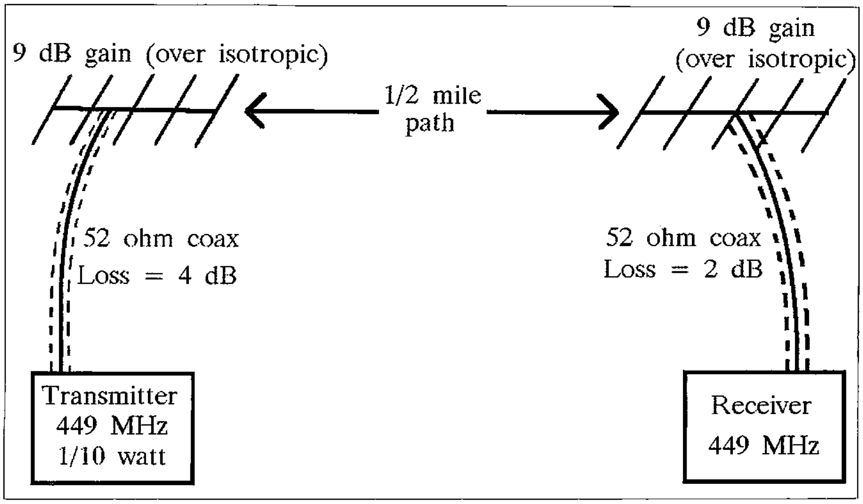


Fig. 4. A practical example from ham radio.

In our example, for instance, we had a power density of 2.60 microwatts per meter^2. The field strength is therefore

$$\text{Field strength} = \sqrt{.00000260 \text{ watts/m}^2 \times 377 \text{ ohms}}$$

$$= \sqrt{0.00098}$$

$$= 0.031 \text{ volts/meter.}$$

Like some other concepts in antenna work, field strength is somewhat theoretical. It is based on the idea that, if you could somehow stick two voltmeter probes into the air, exactly one meter apart, the meter would measure a voltage of (in this case) 0.031 volts. This is not really possible, of course; actual field strength meters measure the field strength by measuring the output from a calibrated antenna.

Field strength calculations can be useful if you ever get your hands on a calibrated field strength meter, but otherwise are not very useful.

Capture area

As you remember, power density is the amount of power that hits a one-square-meter area at some distance from the transmitter antenna. Let's now place an antenna at that point, and make the antenna exactly one square meter in size. If the antenna can capture all the power hitting it, it will receive the same amount of power. For example, if the power density was 2.60 microwatts per square meter, as in our previous example, a one-square-meter antenna would receive 2.60 microwatts of power. If that antenna was two square meters in area, then it would receive twice as much power, etc.

The catch is that the actual physical area of an antenna doesn't always match exactly the amount of power it captures. Some antennas simply don't capture enough of the signal hitting them, while others capture more signal than their size would indicate—they seem to "reach out" into space around them to capture some signal that would otherwise pass on by. So, rather than talk about their physical area, we consider the effective or working area.

The effective area of the antenna is called its capture area. Once we know the capture area, we can compute how much signal the antenna actually receives from the formula

received power = power density x capture area.

The greater the capture area of a receiving antenna, the greater the amount of power it picks up out of the air and sends to a receiver.

As with so many other antenna concepts, the idea of a capture area is purely theoretical. For instance, if it really did what it sounds like it does, namely capture all the power existing in a certain area of space, then a second antenna placed behind the first antenna would pick up no signal at all, and we know that is not true. Similarly, putting a reflector behind a dipole would do nothing because there would be no signal there to reflect, whereas we know that reflectors are commonly used in beam antennas. Still, capture area is a useful

concept because it allows us to calculate other antenna parameters. Specifically, it lets us know how much RF signal a given antenna will pick up and deliver to the receiver.

Measuring the capture area, however, is difficult, so we usually work backwards. Instead of estimating capture area and using it to calculate the gain, we measure the gain and use it to calculate the capture area. The gain of an antenna can be measured by comparing it with that of an antenna with a known gain (such as a half-wave dipole). Once we have that, we calculate the capture area from the following equation:

$$\text{capture area} = \frac{\text{Gain x wavelength}^2}{4\pi}$$

where Gain is the gain compared with an isotropic antenna (expressed as a number, not as dBi), and the wavelength is simply the wavelength of the signal which the antenna is trying to pick up.

Let's justify the equation. It's easy to see why the Gain term is in it—if you double the gain of an antenna, that means it picks up twice the signal, which means that it has twice the capture area.

But why the wavelength^2 term, and why is it squared? Let's consider an example. Let's assume that we have a 3 dBi antenna of, say, 2 by 3 feet. Let's now build an identical type of antenna, but for half the frequency. This new antenna will also have 3 dBi gain, since it is the same type of antenna. Yet every dimension of the new antenna has to be twice as large (because the wavelength is twice as large), and so it has a capture area four times as large. So, although the gain has stayed the same, the wavelength has doubled and the capture area has gone up by a factor of 4. So the capture area is proportional to the square of the wavelength.

Practical example

Fig. 4 shows a typical problem from amateur radio. It shows a 0.1 watt transmitter on 449 MHz, feeding a 9-dB-gain beam through a coax which has 4 dB loss. At the receiver, 1/2 mile away, a similar antenna feeds a receiver through a 52-ohm coax having a loss of 2 dB. Under these conditions, how much signal will the receiver get?

Our calculations go like this:

1) Transmitter power is 100 milliwatts into the coax.

2) The antenna has 9 dB gain, but there is 4 dB loss in the coax cable feeding it, so the total power gain is only 5 dB (in the desired direction!). A 5 dB power gain is a power ratio of 3.16, so the power actually radiated toward the receiver is the same as an isotropic antenna would radiate if it was fed with

3.16 x 100 = 316 milliwatts.

In other words, the ERP is 316 mw or 0.316 watt.

3) A half mile is 1609/2 meters, or 805 meters. The power density at that distance is thus

$$\frac{ERP}{4\pi r^2} = \frac{0.316\ \textit{watt}}{4 \times 3.14159 \times (805)^2} =$$
0.0388 microwatts/meter^2.

4) 9 dB antenna gain on the receiver is a power ratio of 8. (Here's a shortcut to figure that out: 9 dB is 3 dB + 3 dB + 3 dB. Since each 3 dB power gain doubles the power, the power increase is 2 x 2 x 2, or 8.)

The wavelength at 449 MHz is

$$\frac{3 \times 10^8 \text{ meters/sec}}{449 \times 10^6 \text{ cycles/sec}} =$$
0.668 meters/cycle.

With a 0.668 meter wavelength and a gain of 8, the receive antenna's capture area is

$$\frac{\text{Gain x wavelength}^2}{4\pi} =$$
$$\frac{8 \times (0.668\text{ m})^2}{4 \times 3.14159} = 0.284\text{ m}^2$$

and so the received power at the receiver's antenna is

received power = power density x capture area

= (0.0388 μw/m^2) x 0.284 m^2

= 0.011 microwatts.

5) Another 2 dB is lost in the receive coax line; we translate that to a ratio of 1.59 using the equation

$$2\text{ dB} = 10 \log \frac{P_2}{P_1}$$

so the power arriving at the receiver is only

$$\frac{0.011\text{ microwatts}}{1.59} =$$
0.0069 microwatts.

6) Since $P = V^2/R$, we can find the actual voltage at the 52-ohm receiver input:

$V^2 = P \times R$

$V = \sqrt{P \times R}$

$= \sqrt{6.9 \times 10^{-9}\text{ watts} \times 52\text{ ohms}}$

$= 5.99 \times 10^{-4} = 600$ microvolts.

"Figures lie, and liars figure"

Time to tell the truth. The above numbers are all nice and exact—but in practice, things never quite work out like that. There are a number of other factors which don't show up in the math, such as

•What is between the transmitter and receiver antennas?

•Do they have a clear line of sight between each other, or are there obstructions? The above math assumes a line of sight.

•What about the curvature of the Earth—if the antennas are low enough, the Earth may obstruct the path between them.

•Are there any reflections from other objects? Nearby buildings or hills can provide reflections, but so can the earth below! Earth reflections are less likely with vertical polarization, but they can still occur. And reflections can either add to the signal, or cancel part of it; either way, the actual signal strength at the receive antenna can be drastically different.

•How about the coax, antennas, and connections—are they in good shape, or are there additional losses due to old age, moisture, rust, or other factors?

•How well are the antennas aimed?

•Is the polarization of both transmitter and receiver antennas the same?

•And yes... did the antenna manufacturer tell the truth in specifying 9 dB gain?

Since there is so much variability in these factors, it is usually a good idea to assume that the results could be off by a factor of 10 or more. In other words, a real-life system had better provide ten times more power than the calculations indicate is needed. Still, such calculations do give you a rough idea of the *minimum* reasonable power that might do the job.

Path loss

In the above example, we started with a transmitter output of 100 milliwatts and wound up with only 0.0069 microwatts at the receiver. This is a total loss of

$$\text{Loss } in\ dB = 10 \log \frac{0.0069 \text{ microwatts}}{100 \text{ milliwatts}}$$

$$= 10 \log \frac{6.9 \times 10^{-9} \text{ watts}}{1 \times 10^{-1} \text{ watts}}$$

$$= 10 \log (6.9 \times 10^{-8}) = -71.6 \text{ dB}.$$

Let's see what the signal had to go through on its way from the transmitter to the receiver: a cable at the transmitter; a transmit antenna; half a mile of air; a receive antenna; and some cable at the receiver. Let's then add up the losses in each of these:

Cable at the transmitter	-4 dB
Transmitter antenna	+9 dB
1/2 mile of air	-X dB
Receive antenna	+9 dB
Cable at the receiver	-2 dB
TOTAL	-4 + 9 - X + 9 - 2 = +12 - X dB

But we already know that the total loss is 71.6 dB, so

$$+ 12 - X \text{ dB} = 71.6 \text{ dB}$$

$$X = 83.6 \text{ dB}.$$

In the above example, the antennas actually contributed an 18 dB gain (9 dB for each antenna), while the cable loss added up to 6 dB (4 dB at the transmitter, 2 dB at the receiver). This adds up to a total gain of 18 - 6 = 12 dB. In other words, we had an effective gain of 12 dB in the antenna systems, and still lost 71.6 dB in the transmission; this means that the loss in the 1/2-mile path was actually 71.6 + 12 = 83.6 dB. This is called the path loss.

"Did the antenna manufacturer tell the truth?"

The path loss is actually dependent only on the distance and the frequency. It is calculated by assuming that isotropic antennas are used at both the transmitter and receiver, and there are no other losses in the coax cables. We then use the foregoing equations to calculate, step by step, the received power in relation to the transmitted power.

Alternatively, we can combine all of the above equations into one big equation which gives the path loss directly in dB:

$$\text{Path loss } in\ dB = 10 \log \frac{(4\pi)^2 \times \text{distance}^2}{\text{wavelength}^2}$$

where both the distance between the transmitter and the receiver, and the wavelength, must be given in meters.

The path loss is useful not only in cases where we want to get a signal from one place to another, but also in cases where we don't. For example, suppose a 2-meter receiver is located 1/5 mile (322 meters) away from someone else's transmitter on a nearby frequency; in other words, the nearby transmitter might interfere with our efforts to receive a weak signal. How much interference will the transmitter cause to the receiver? The path loss is a guide to how much the transmitted signal will be attenuated in the 1/5-mile path:

$$\text{Path loss } in\ dB = 10 \log \frac{157.91 \times (322 \text{ m})^2}{(2 \text{ m})^2} = 66.1\ dB.$$

This means that if both the transmitter and receiver have isotropic antennas and no loss in the coax, the received signal will be 66.1 dB weaker than the transmitted signal. In an actual case, you would have to add in any antenna gains, and then subtract cable or other losses, so the actual signal loss might be smaller once these are taken into account.

Quartz Crystals

An overview of these frequency controllers.

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266

Hams have been fascinated by quartz crystals since their first use. They and other people involved in radio have used quartz crystals for many years, perhaps without understanding the material.

Quartz has been recognized for at least 7,000 years and was originally used as jewelry. Around 1880 Professor Pierre Curie discovered the piezoelectric effect of quartz. This effect is the one used in radio crystals; it refers to the vibration of the crystal in the presence of an electric field.

Dr. Walter G. Cady took out a patent in 1920 on quartz as a means of controlling and measuring radio frequencies. At the time, most transmitters were self-excited and lacked frequency stability. With few stations and lots of frequency spectrum to work with, the instability was of little concern.

However, today it is another matter. Frequency stability and control are extremely important with the crowded bands. Quartz crystals have provided the means of controlling frequencies easily. Not too long ago, a radio required a crystal for every discrete frequency; today only one or two crystals are required in a frequency synthesizer to provide the stability required for all of the frequencies generated by the synthesizer.

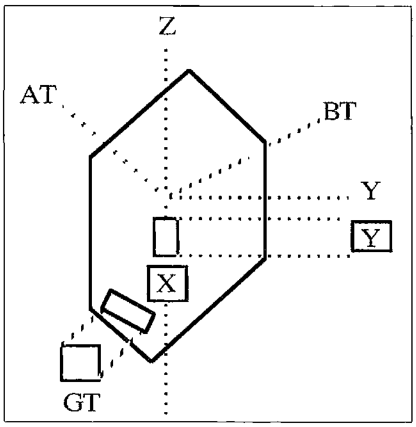


Fig. 1. Some of the different cuts available from a quartz bar.

Synthetic quartz

At one time, all of the quartz used for radio crystals was natural quartz material. Most of the world's supply of radio grade quartz was obtained from South America, and specifically from Brazil. But with a diminishing supply of high grade radio quartz and with increased demand, the development of synthetic quartz increased rapidly. Synthetic quartz, also called "cultured" quartz, was developed in 1845, even before piezoelectric effects were known.

Synthetic quartz is grown using hydrothermal techniques. Polycrystalline quartz is dissolved in a hot alkaline solution and then re-crystallized. Fragments of natural quartz are used as seed crystals to start the process by providing the model for crystalline structure growth from the solution.

The difference between natural and synthetic quartz is minimal as far as users are concerned, and usually involves imperfections in the crystalline structure of the synthetic material. These imperfections are detected and discarded at the time of material grading, before making usable radio crystals.

It is interesting to note that the structure of synthetic quartz is considerably more uniform than natural quartz. The purity of synthetic quartz has provided a higher yield of radio grade quartz than was ever obtained from natural quartz. The final result is a lower cost to the user.

When a crystal is ordered from the factory, the user seldom knows much more than whether the crystal is a fundamental or overtone type. **Fig. 1** shows some of the different cuts from the quartz bar. Each of the cuts has a name, such as AT, BT, CT, GT, etc. The various cuts exhibit different characteristics, which crystal manufacturers take advantage of to produce a crystal suitable for each application.

The crystal bar has three main axes, X, Y and Z. These axes are really directions and are related to the physical property of the material (**Fig. 2**). The Z axis is the easiest to identify because it runs the long way from end to end of the bar. The X axis runs in a direction through the corners of the bar and 90 degrees from the Z axis. The Y axis is a direction through the flat side of the bar and 90 degrees from both the X and Z axes. All of the specific crystal cuts are oriented from these axes.

Quartz use applications

The first usable cuts made from a quartz bar were from the X axis. Later the Y cut was introduced because it was easier to excite in an oscillator circuit than an X cut. However, the Y cut stability tended to be poor and it could change frequency abruptly. During World War II, crystal cuts such as AT, BT and CT were developed to reduce the effects of

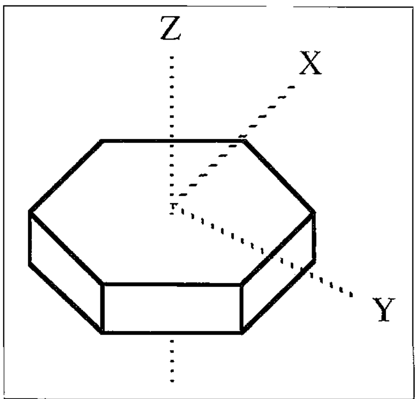


Fig. 2. Quartz bar slice, showing the X, Y and Z axes.

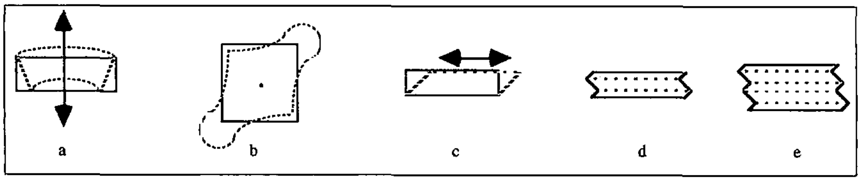


Fig. 3. Relative frequency range and mechanical movement: (a) Fundamental flexure mode 10 kHz - 100 kHz. (b) Fundamental face shear 180 kHz - 1 MHz. (c) Fundamental thickness shear 1 - 20 MHz. (d) 3rd overtone 5 - 61 MHz. (e) 5th overtone 50 - 125 MHz.

temperature and abrupt shifts in frequency. The AT cut is now the most popular for radio applications, but BT, CT and GT cuts are used extensively to meet stability and overtone requirements as a function of temperature and excitation.

A quartz crystal is cut with a saw running in a slurry containing diamond dust. Originally only one saw blade was used, allowing one crystal blank to be cut at a time. Now, a gang saw is used so that many crystal blanks can be cut in a single pass. Once cut, each blank is graded and finished to customer requirements.

Quartz responds to the effects of an electrical field by creating a mechanical movement (piezoelectric). The relative frequency range and mechanical movement are shown in **Fig. 3**. Fundamental low frequency crystals with their large mass vibrate to create the appearance of a pillow. At higher fundamental frequencies, the crystal appears to squirm (rotate about its center line). During overtone operation, the crystal appears to vibrate in shear. The number of shear layers produced are odd in number; that three layers produce the third overtone (third harmonic of the fundamental). Five layers would produce the fifth overtone, etc. The overtone frequency produced, although not controlled by the fundamental mode, is a near multiple of the fundamental (about 25 kHz per overtone higher). When being produced, the crystal is processed for the end use frequency and overtone mode of operation with no concern as to what fundamental properties it might have.

In operation, the quartz crystal functions just like a coil and capacitor in a resonant circuit and can function as either a series or parallel resonant circuit. Fig. 4 shows the equivalent circuit of a crystal which can be used to define the operation of the crystal exactly. The inductance L represents the mass of the crystal, the capacitance C1 represents the resilience, and the resistance R represents the frictional losses. Capacitor C2 represents the crystal electrodes across the crystal as a dielectric. Capacitor C3 represents the series capacitance of the crystal and the electrodes. Depending upon the mode, the circuit can represent either a series or parallel resonant circuit. When the combined reactance of C1 and L are inductive and equal to the reactance of C2, the crystal will operate in the anti-resonant mode (parallel resonance). When the reactance value of L equals C1, the crystal will operate in the resonant mode (series resonance).

When operating a crystal in an oscillator circuit, capacitor C2 may be paralleled with a trimmer capacitor to cause a small change in the crystal's anti-resonant frequency. If the crystal is operating in the overtone mode, either series inductance or capacitance will cause a crystal frequency shift. External frequency adjustment must be used sparingly as crystal stability will be affected. **Fig. 5** shows the reactance curve of a quartz crystal and the small difference between the resonant and anti-resonant points. Notice that the resonant (series) frequency is slightly lower than anti-resonance (parallel). In the resonant mode, the crystal exhibits a low impedance across its terminals, and a high impedance across its terminals when in anti-resonance.

One of the biggest user concerns about quartz crystals is the aging factor. In other words, how much will the crystal drift after it is placed in operation? Quartz crystal aging applies to the cumulative change in frequency, which results in a permanent change in the operating frequency. The rate of change is the fastest during the first 45 days of operation. Many interrelated factors are involved in aging, some of the most common being internal contamination, excessive drive, surface change of the crystal, various thermal effects, wire

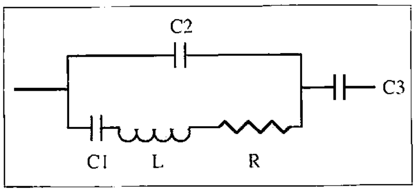


Fig. 4. Equivalent circuit of a crystal which can be used to exactly define the operation of the crystal.

fatigue and functional wear. Proper circuit design incorporating low operating ambients, minimum drive level and static pre-aging will greatly reduce all but the most severe aging problems.

Vibration

Quartz crystals vibrate when operating due to their piezoelectric characteristic, although the amount of vibration is quite small in relation to the physical size of the crystal. Even though small, the vibration causes stresses in the structure, which generates heat. If not kept within limit, the internal stress can cause permanent damage through rapid aging and/or fracturing. Excessive oscillator drive can cause severe stresses to occur. Once fractured, of course, the crystal is no longer of any value.

Vibration of the crystal also creates heat which can adversely affect the operation and stability of the crystal. Frequency drift is the usual symptom of heat. To keep the crystal temperature down, the oscillator drive level must be kept as low as possible, usually below 1 mW for crystals used as a standard frequency reference. Overtone crystals may require 1-2 mW of drive, while fundamental crystals operating below 10 MHz may require up to 10 mW. The drive level should be cut by 50% of the above indicated values when the crystal is used in an oven.

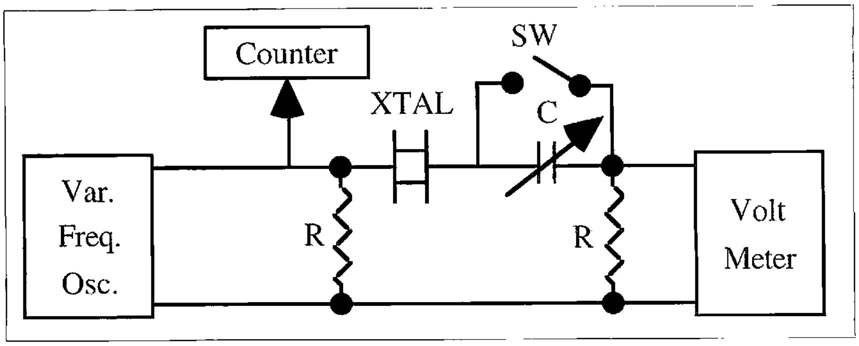


Fig. 6. Crystal test circuit.

The amount of crystal drive is usually related to the amount of crystal activity required, and in this case refers to the ability of the crystal to vibrate. Some crystal test oscillators have a meter in the circuit to indicate the relative strength of activity. The amount of crystal activity indicated by a meter is vague, but nevertheless provides a reference.

Many things control the amount of activity that a crystal will exhibit. For the older style pressure-mounted crystals, dirt and mounting conditions were a major factor. Modern hermetically sealed crystals are not affected by the environment. Therefore, manufacturing techniques, the Q factor of the cut and frequency will affect the drive level requirement. Of importance, though, is the ability of the crystal to start easily in the circuit and maintain a given frequency. The amount of drive applied should be just high enough to create reliable oscillator stability and operation. A large drive value could cause fracturing or excessive aging.

Testing a crystal

Parameters of a quartz crystal can be tested by placing the crystal into a passive network, as shown in **Fig. 6**. A variable frequency oscillator is used to drive the crystal, which is mounted in a pi network of equal value non-inductive resistors. An RF voltmeter is placed on the output to measure the signal transferred through the network. For phase angle measurements, a vector voltmeter may be placed in parallel with the crystal. Being passive, the crystal will respond to the drive frequency at both its resonant and anti-resonant frequencies. Actually, the crystal operates/responds as a filter. Using this network, it is possible to measure the phase angle of the voltage across the crystal (zero degrees equals resonance, 180 degrees equals anti-resonance), determine the crystal impedance and equivalent resistance and determine the crystal's load capacitance. The load capacitance can be determined by placing a capacitor in series with the crystal while it is connected in the network and then measuring the voltage vector across it. As an example, the frequency of the oscillator is set to the anti-resonance frequency of the crystal (180 degrees of phase shift across the crystal), then the value of the series capacitor is adjusted until a phase angle of 180 degrees is obtained across it. The total phase angle between the oscillator and network output is 360 degrees. The value of the series capacitor is equivalent to the load capacitance value (typical values range from 20 to 32 pF).

Not all of the parameters are needed to use the crystal in an oscillator; but the more that are known, the simpler it is to design the oscillator.

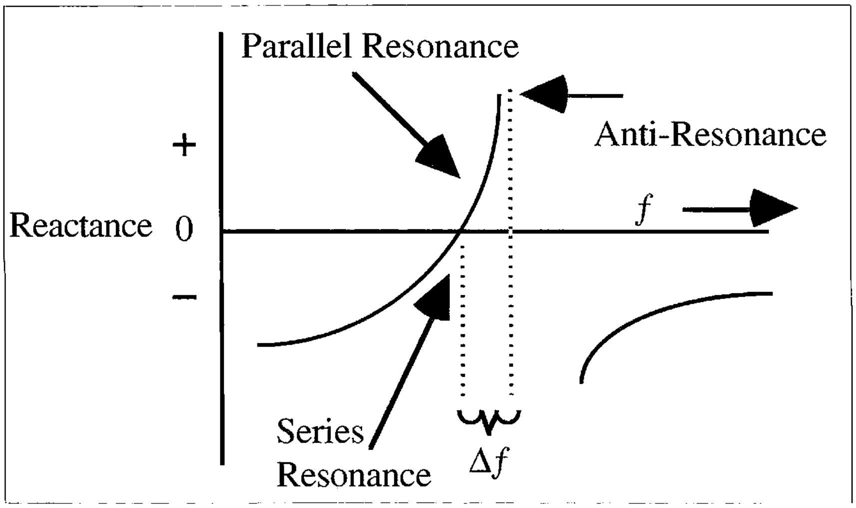


Fig. 5. The reactance curve of a quartz crystal.

10 Meters Lives!

Don't let the sunspot cycle fool you.

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

Have you tried 10 meters lately? I know. I know. We're at or near the bottom of the sunspot cycle and 10 meters is useless—or *is* it?

I've been finding this band opening up frequently. It often opens from the late morning through the afternoon. I've also found it open occasionally to as late as 10:00—at night! One recent Saturday evening I got on 10 meters at 8:00 p.m. and worked K2YJL/mobile in Kentucky running a Uniden 2510, NØKXL in Kansas running a Uniden 2510, and KF4BGR in Florida running an Emperor TS-5010. K2YJL told me he has confirmed 170 countries over the past two or three years operating mobile with his Uniden 2510 and Hamstick™ antenna! I suspect that 10 meters has *always* had openings, even during lows in the sunspot cycle. Most rigs nowadays have scanning capability. Go ahead and put your radio on scan so you'll find out when the band opens. Incidentally, the belief that 10 meters is dead has resulted in some great deals on the above-mentioned rigs. To give you a personal example, I recently traded an unused microphone for a mint condition HTX-100!

OK, you've scored that 10-meter rig from a less-than-savvy, but happy, previous owner (he thinks *you* got the short end of the deal). Now you need an antenna or two to get going.

For 10-meter base station operation, I recommend a high horizontal antenna. I've found that a high horizontal antenna usually outperforms a ground-mounted vertical or ground plane antenna by several S-units.

Recycle that, good buddy!

Look for used CB antennas at hamfests. A dipole made from two slightly shortened CB whips back-to-back at 20-25 feet up in the air will do a great job. For the dipole center, use a PVC "T" attached to the top of a PVC or aluminum mast attached to your chimney with a cheap hardware-store chimney mount.

To attach the CB whips to the PVC "T," use PVC reducers and 1/8-NPT brass adapters as shown in **Fig. 1** (all available from your local hardware store). As it turns out, 1/8-NPT is the same as a slightly tapered standard 3/8 x 24 antenna thread. You can chase the 1/8-NPT threads with a 3/8 x 24 tap but this isn't really necessary unless you'll be screwing and unscrewing the elements frequently.

Pick the "T," reducers, and adapters to fit your mast. The 3/4" PVC "T" shown has an inside diameter of one inch, because it must pass over the one-inch outside diameter of 3/4" PVC pipe and so it will take a one-inch OD aluminum mast. The CB whip bases screw directly into the 1/8-NPT thread.

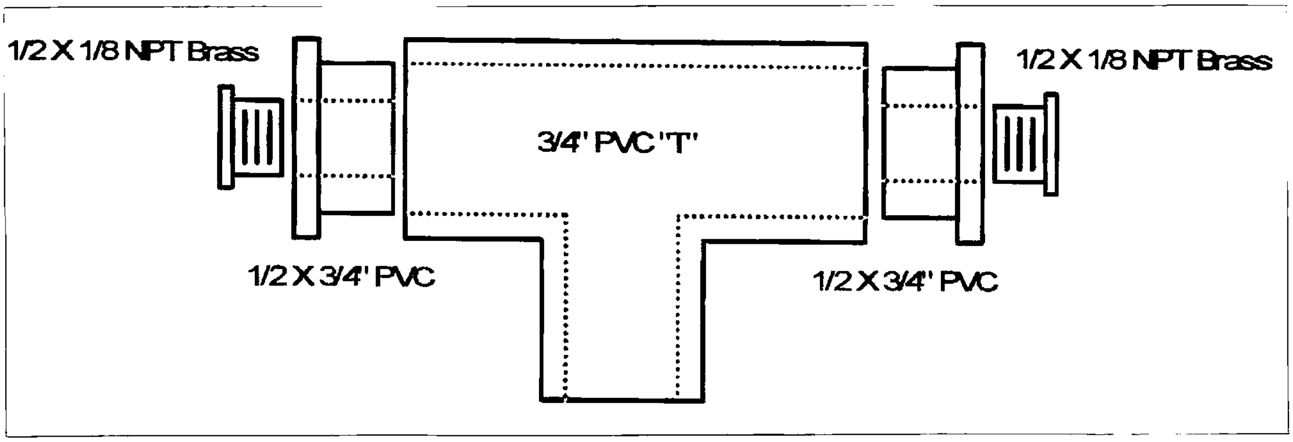


Fig. 1. Dipole center piece.

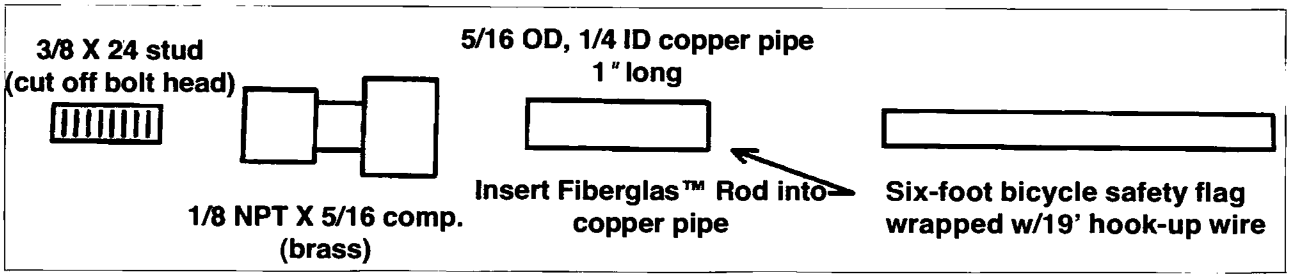


Fig. 2. Mobile antenna details.

To attach your coax, drill and tap holes in each of the brass adapters to take a #6 brass screw. Attach a solder lug to each adapter with brass screws (use brass or copper lockwashers). Solder the shield to one solder lug, and the coax center conductor to the other solder lug.

Alternately, you can just drill a small hole in each brass adapter and solder a wire to the hole to use as the connecting point for your coax (solder to the brass adapters *before* they are mounted in the PVC, or you'll have a melted PVC mess on your hands!).

If you're a real purist, you can also add a balun, but that's not really necessary if your coax exits the antenna at right angles and stays that way for a while.

Goin' mobile

When you're shopping for those used CB antennas for your base station dipole, think about a *third* CB whip for your car. Operating mobile will add another exciting dimension to your ham fun. The Uniden, Radio Shack, Lincoln, Emperor, etc., rigs are all small enough to fit easily in all cars. My Uniden 2600 mounts vertically on the transmission hump in my Geo Metro and causes no problems to the passenger (normally the ever-critical spouse). Incidentally, the CB antennas need to be shortened about four to five percent to put them on 10 meters. An MFJ or Autek SWR analyzer will permit you to get everything perfect in an amazingly short time!

Mobile antennas for 10 meters can be made inexpensively by shortening CB antennas as mentioned above—but you can "roll your own" low profile (six feet) 10m mobile antenna for even less!

As you can see in **Fig. 2**, a mobile antenna can be built from a 6-foot Fiberglas™ bicycle safety flag (around $3 at discount stores), 19 feet of #22-24 hookup wire, a one-inch-long piece of 5/16" OD (1/4" ID) copper pipe, a 1/8-NPT x 5/16 compression brass adapter, a 3/8 x 24 bolt, and some 3/8" heat-shrink tubing.

To build this antenna, solder one end of the hookup wire to one end of the one-inch-long copper pipe. Put some epoxy on one end of the Fiberglas rod and slide this end of the rod into the copper pipe. Next, insert the copper pipe into the 5/16" compression fitting and tighten. Screw a 3/8 x 24 stainless-steel bolt into the 1/8-NPT end of the brass adapter and tighten securely (the 1/8-NPT tapered thread makes a nice interference fit). Cut off the head of the 3/8 x 24 bolt and file off the rough edges as necessary so it will screw into a 3/8 x 24 mount. Now, wrap the wire evenly around the whip and hold the end of the wire in place temporarily with masking tape. Mount the antenna on your car and check the resonant frequency with your SWR analyzer.

"Operating 10m mobile will add another exciting dimension to your ham fun!"

If the resonant frequency is too low, you can either remove some wire or compress the turns at the top of the antenna. If the resonant frequency is too high, compress some turns around the center of the antenna. With just a little effort, you can adjust the turns and turn spacing to resonate this antenna right where you want it. Incidentally, the SWR at resonance will probably be around 1.5:1. Since most radios aren't bothered by a 2:1 SWR and the cable loss will be negligible, you really don't need to worry about this "high" SWR. However, if you want a perfect 1:1 SWR match, connect a 25 pF 500 WVDC silver mica capacitor from the base of the antenna to ground. Make sure you make the antenna adjustments with the capacitor in place.

When the antenna resonates where you want it, add a few pieces of heat-shrink tubing along the length of the antenna to hold the wire in place. You now have a flexible, low profile, and low wind resistance 10-meter mobile antenna for less than $7! This same method works for other frequency band antennas, too.

I turned my Uniden 2600 into a dual-band 10- and 12-meter rig by adding the Chipswitch™ to it, so I also needed a 12-meter mobile antenna. The Chipswitch (available from Chipswitch, 4773 Sonoma Hwys, Suite 132, Santa Rosa CA 95409-4269, FAX 707-539-7571 or phone 707-539-0512), permits continuous operation between 24.5 and 30 MHz for Uniden and Lincoln 10-meter rigs. For my 12-meter mobile antenna, I started with 20 feet of wire and was easily able to get the antenna to resonate in-band.

I also built a 15-meter mobile antenna which required 25 feet of wire. For frequencies below 10 meters, the base matching capacitor becomes more important for keeping the SWR reasonable. I needed 50 pF on 15 meters for a 1:1 SWR.

Ten meters is not as dead as many folks think—and it's easy (and inexpensive) to get on the band. I've given you some hints on obtaining inexpensive 10-meter rigs, and information on building inexpensive base and mobile antennas. When the sunspots finally start to appear, you'll have a head start on all the fun.

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92633

New ideas never cease

Friendly competition, international goodwill, emergency rescues, self-policing, and wildlife management—what do they have in common? All are important uses for radio direction finding (RDF). Whether your interests in ham radio are technical, social, or public service, RDF can play an important part.

When I talked to *73*'s then-editor Bryan Hastings NS1B in the summer of 1988 about a monthly RDF column, he was interested but skeptical. He asked, "Do you really think there is enough material for a full year of columns?" I nervously assured him that I had a long list of topics.

Next month's "Homing In" will be Number 100. With your help, this department has presented stories of transmitter hunters in action from cities and towns all over the country. There have been reviews of new commercial RDF gear and projects to build at home; also, the first detailed coverage by a major ham magazine of APRS, LoJack™, and Teletrac™ has been on these pages. There was even a turtle-tracking expedition. Despite all this, my list of potential topics is longer than ever. Technical innovations are coming at an increasing rate and T-hunters are always finding new ways to have fun.

If you are new to *73* and want to see what you have missed in "Homing In," you will find a complete chronological index at my site on the World Wide Web (http://members.aol.com/homingin/). Don't forget the forward slash at the end of the address. If you don't have Web access, send me a self-addressed stamped envelope and I will mail you a copy.

"Some hams from China are proposing a new type of ARDF contest they named the Technical Session."

***Photo A**. Want outdoor fun for your ham club's picnic, hamfest or Scout troop? Hold an IARU-style foxhunt! A new rules proposal makes it easier than ever.*

T-Hunts—grass roots growth

As it was when the first "Homing In" appeared, mobile hidden transmitter hunting is still the most popular use of RDF by hams in the USA, and it's growing. I regularly hear from clubs that have just begun to sponsor T-hunts. A good example is the Silver Creek Amateur Radio Association (SERA) of Doylestown, Ohio, near the cities of Akron and Canton. According to Jim Korenz N8PXW, SERA holds hunts once a month, except in winter. They start from a shopping center parking lot in Doylestown or Barberton.

"Most of our hunts are not too sophisticated," Jim says. "They run about 20 or 30 miles maximum. Parts of the area are rural but it's still fairly urban. Most of the time, the person with the fox is in a car by the side of the road or in a park."

Simple 2-element quads or yagis are most popular for 2m RDF in N8PXW's area. Jim prefers his home-built Roanoke Doppler with a wideband antenna set of four magnetic-mount whips (see "Homing In" for April and June 1995). Having learned about microcontrollers on the job, he decided to see if they could augment his setup. "I acquired a Motorola GPS board in Dayton and decided to link the two together," he told me. "I increased the clock frequency from 8 kHz to 64 kHz. This gave me 7 bits of angle data. I got the eighth bit from the clock chip. I latched the data with a 74LS374 octal latch and fed it to a Motorola 68705P3 microcontroller by way of the 8-bit data port.

"The processor converts the 256 counts into 360 degrees, puts the number into an ACSII message, and transmits this data via RS-232 to a display processor for the GPS," N8PXW continues. "That display processor is also a home-built 68705P3 unit, which receives the NMEA format messages from the GPS, parses the data, and sends the values to the LCD display. It also receives the Doppler data, adds the GPS-determined heading for the vehicle, and displays the signal bearing relative to true north.

"The GPS processor outputs the latitude, longitude, and bearing as an ACSII message from another RS-232 port. The data is sent only when the vehicle speed is greater than 5 mph and three or more satellites are seen by the GPS. I tried to average the bearing data with the processor, but the eyes seem to do a better job."

As experienced hunters know, the performance of Dopplers versus RDF beams depends on the nature of the hunt. "The Doppler usually works very well," Jim says. "On my first hunt, I arrived about 20 minutes before anyone else, but I placed second because the hunt was scored by mileage, and mine was one mile longer than the winner. The worst experience with the Doppler was when I was within a half mile of the T in a dense forest of large trees. All the indicator did was continuously spin around in circles with no obvious direction."

SERA hams have learned that a prepared group of T-hunters helps to minimize malicious QRM on local repeaters. "Last year we had a jammer who would put out whistles and dead carriers," says N8PXW. "At first he was on maybe once a week, but by Christmas he was on all the time, including midnight and early mornings. So four teams started looking one night. Home stations with beams said he was south of Doylestown, so we took

off and ended up in the country with no signal to hunt. Now I know what it feels like to be a private eye—a lot of sitting on lonely roads with people going by saying, 'What are you doing out here? It's 20 degrees!'

"A couple of nights later, the whistler was on pretty solid again," Jim continues. "I could hear him on the input from home, so we went out again. I got out on the freeway past the local airport and the Doppler kicked in, pointing due south. I got three good bearings and then the signal stopped for the night. The readings crossed in the city of Massillon.

"We all went down there the next night. I couldn't detect the signal from the south and east of Massillon, but some of the other guys picked it up from the west and north. We didn't find it. However, one of our young hams got on the repeater next morning saying, 'My dad was out in Massillon, real close to the jammer.' We haven't heard the QRM since."

For the latest SERA hunt schedule, send E-mail to: w8wky@amsat.org. If you are in the area, call on the 147.39 repeater.

ARDF—a new attitude

On-foot radio-orienteering (ARDF) is the fastest growing form of competitive direction finding outside the USA. In many countries of Europe and Asia, it is a school sport with regional, national, and international championships. North America has a long way to go to catch up to the level of ARDF activity in International Amateur Radio Union (IARU) Region 1 (Europe/Africa) and Region 3 (Asia and South Pacific). Nevertheless, this year's spring thaw will bring out ARDF enthusiasts in several cities of North America.

At the ARDF Working Group meeting in Bulgaria last year, a new age category, Veterans, was officially added to European events. In it are men age 56 and older. Seniors (men ages 19 to 40) must find all foxes on the course to win. Contestants in other categories, including Veterans, need to find only four.

With the addition of Veterans, there are now four categories for males and only one for females (see **Table 1**). The four-to-one ratio did not sit well with some delegates. A formal proposal was put forth one month later to have four categories for women as well, with the same age ranges. The proposal, written by OK2BWN and DL5NBZ, would require those in the M20 category (men ages 19 through 40) to find all five foxes. Males and females in all other categories need find only four, except for D56 (women 56 and older) who would have to find only three.

Is the proposal fair or is it discriminatory? That will be debated by the Region 1 ARDF Working Group when it meets in Germany this September. Meanwhile, you can read the complete proposal text at the "Homing In" Web site.

A serious impediment to the growth of stateside ARDF is the mandatory logistics and organizational effort. IARU's official "Rules for Championships in ARDF" is 12 pages of fine print that specifies in great detail how courses must be set up and competitions must be run. Following these rules requires carefully synchronized transmitters, individual timing and starting of competitors, plus other restrictions that make it necessary to have a staff of non-hunters to oversee the event.

2m IARU championships must use AM transmitters and MCW fox signals, which are incompatible with the equipment and skills of most new hams. The courses are large (at least 500 acres), so only true athletes have a chance of winning. With the realization that these rules and restrictions are discouraging many ham hobbyists from trying ARDF, some hams from China are proposing a new type of ARDF contest that they named the Technical Session.

	VHF Class (IARU Rules)	Technical Session (BA1HAM Proposal)
Categories	Juniors (boys under 18) Seniors (men 18 to 40) Old Timers (men 41 to 55) Veterans (56 and older) Women (any age)	Youngsters (boys under 14) Gentlemen (men 15 to 55) Old Timers (56 and older) Ladies (any age)
Site	Predominantly wooded	Any kind of field
Total course distance	5 to 10 kilometers	1 to 3 kilometers
Number of foxes	5	8 to 12
Min. fox separation	400 meters	5 meters
Verification method	Distinctive punches at foxes	Unique control numbers
Dummy controls?	No	Yes, 2X to 5X number of foxes
Fox placement	Visible with red/white flags	Concealed, invisible
Mode	2 meter AM	2 meter FM simplex
RF carrier	Keyed and modulated	Modulated
Transmitter power	0.25 to 1.5 watts	100 to 200 milliwatts
Antenna polarization	Horizontal	Vertical
Foxes heard at start	All	At least half
Identification	8-12 WPM CW, MOE, MOI, etc.	Slow CW, single character
Timing	1 minute on, 4 minutes off	3 seconds on, 30 seconds off
Synchronized?	Yes, in numbered sequence	No, slight timing variations
Map	1:20,000 orienteering	Simple with roads and buildings
Start method	Five minute intervals	All together

Table 1. Comparison of rules between the traditional IARU two-meter foxhunt and the proposed Technical Session. The total course distance is the minimum path from start to each transmitter and then to the finish.

Chen Ping BA1HAM has circulated a draft proposal. If adopted, a Technical Session would be added to regional and national championships. It would be separate from the existing 80m CW and 2m AM events, with separate competitor categories and prizes. **Table 1** shows my comparison between rules for the traditional 2m run and the Technical Session. The proposal text can be downloaded from the "Homing In" Web site.

Technical Session courses would be smaller than those of other IARU foxhunts, so they could be held in city parks and school grounds. Besides the obvious convenience, a small course makes the outcome more dependent on RDF skills and less on the ability to run fast. Other features would make it possible for visitors and observers to be on the grounds during the event and for contestants to use commonly available VHF-FM receivers and scanners.

Note that age categories are slightly different from mainstream IARU foxhunts, to recognize the differences in technical abilities between children and teenagers. Furthermore, entrants in all Technical Session categories are expected to find all foxes; the number is not reduced for any category.

As an additional incentive to improve RDF abilities, foxes would be truly hidden, with no prominent flags nearby. Numbered markers replace the present orienteering punches. Competitors would write down the number on their cards when they find a fox. To make sure that hunters use their RDF gear instead of just their eyes, there would be many dummy markers in the field. Hunters who write down a dummy number on the card instead of a correct number will score lower.

The Chinese are by far the strongest ARDF competitors in IARU Region 3. They took individual and team gold medals at the Championships in Australia last summer. BA1HAM is Chairman of the IARU Region 3 ARDF Committee. Thus you can be sure that the Technical Session proposal will be given serious consideration by radio-orienteers worldwide.

I like the proposal, because it sanctions foxhunts in local venues with commonly available equipment. However, I would like a more descriptive name such as Short Course or FM Event. Furthermore, I suggest that voice identification be permitted to replace CW for some or all foxes at the event organizers' discretion. Voice memory ICs are plentiful and inexpensive, making talking foxes more practical than ever. They would encourage non-hams and no-code licensees to try ARDF.

The only problem that I envision is security of the marker numbers. Runners should be cautioned to keep their cards concealed so that others on the course cannot see the marker numbers written on them. Course marshals must be watchful to prevent collusion among team members by sharing of numbers. Do you have any ideas for a simple but more secure verification system?

Let's try it

The Technical Session structure is ideal for a foxhunt at the site of your next hamfest or club picnic. So why not hold one? Let's try the proposed rules and see how they work. If you can't put out a dozen foxes, try it with a half dozen or fewer. Here's how to do it:

Visit the site in advance to choose a starting area and a finish area. If everyone starts at the same time, the start and finish can be at the same place. Putting the start/finish area at the center of the venue will encourage hunters to scatter instead of follow one another.

It is not necessary that all foxes be copyable from the start point, but at least half of them should be. The entire hunt area should be free of hazards such as highways, railroads, and dangerous animals. Mark on the map any area with hazards so that no one will venture there.

Make up carry-along cards to give each hunter. There should be a square on the card for each fox, into which the hunters will write the control number for that fox. Standard orienteering cards by Silva have 20 squares and are ideal for this purpose.

The easiest way to make foxes for a Technical Session is to borrow some handie-talkies. Older models such as the Icom IC-2A are perfect, because bells and whistles such as CTCSS are unnecessary. Voice ID can come from an audio chip; on/off timing can be synchronized by a CMOS 555 timer IC. For more controller ideas, see the "Homing In" Web site.

Foxes should transmit for only a few seconds, about twice a minute, sending a distinctive letter in CW or voice. It is OK if transmitters occasionally QRM one another, but try to randomize the timing so that this does not occur on every transmission. Use multiple frequencies only if equipment limitations such as rock-bound transmitters prevent foxes from all being on the same frequency.

Ideally, foxes should begin to cycle just as the hunt starts, so no one can hear them earlier. The versatile PicCon controller described last month can be programmed to start and stop at predetermined times, but most other fox controllers cannot. It may suffice to hold the hunt on an obscure frequency that is not announced until starting time. Forbid hunters from turning on their receivers until then.

Make up about fifty 4-by-6-inch index cards with different 3-digit numbers on them, to be used as control cards. Put the foxes out well in advance so potential hunters won't see you deploying them. Place a control card within six feet of each fox, secured to prevent it from blowing away in the wind. Put out and secure the remainder of the cards at interesting places where hunters might guess that a fox would be located.

Have each hunter register on a roster. Add columns to the roster for start and finish times and number of foxes found. If you have a large enough number of participants, break them into categories with separate prizes for each, to even the field. The Chinese proposal for categories is in **Table 1**, but you could choose differently, as determined by your club's demographics and its opinions about fairness.

Instruct the hunters that they must not turn on their equipment until they begin to hunt. Tell them the hunt frequency and the number of transmitters, plus how the foxes are modulated and identified (voice, CW, letters, numbers, callsigns, and so forth). Give out maps of the hunt area showing boundaries, roads, buildings, terrain features and any forbidden areas.

Start the hunt and begin timing. Make sure you have sufficient help at the finish line to write down exact ending times of each finisher on his or her card and the roster. (The time of finding each fox is not important, just the time that the hunter crosses the finish line.)

Primary scoring criteria is the number of foxes correctly identified by control number. The secondary criterion is time. In a 12-fox hunt, the first to find all twelve wins, followed in time order by all who find twelve, then in time order by all who find eleven, and so forth.

Please let me know what you think of the Chinese proposal. I especially want to hear from clubs that actually try out the Technical Session. I will pass along your results and suggestions to the ARDF Committees of Regions 1 and 3. Send E-mail to: Homingin@aol.com or postal mail to the address at the beginning of this article. Who knows? Maybe there's a future ARDF World Champion in your town!

"The entire hunt area should be free of hazards such as highways, railroads, and dangerous animals."

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119
clhough@aol.com

The VHF/UHF beam antenna

This month, let's cover the construction of an antenna for the 70 cm (432 MHz) amateur band. I didn't want to put together a long-boomer type of antenna with 25 to 32 elements. I wanted to construct a 10- or so element beam on a boom length of six feet. A modest antenna by any measure—not a killer beam. The target price to beat when making a comparison to a commercially available similar antenna was $90 to $100.

I found a good starting point in an article in the May 1989 issue of *Ham Radio Magazine* (pg. 9, K1FO). The task begins by putting together a shopping list of the major components: 1-inch aluminum boom material and a selection of two different tubing sizes for the elements. A larger size is needed for the driven element and still another smaller size for all the others. The ratio of the larger to the smaller diameter should be about 2:1. That is, if 1/4-inch tubing is used for the driven element, the "T"-match section used for the feed arrangement should be 1/8-inch-diameter. The entire antenna is constructed using the 1/8-inch material for all elements except, of course, the driven one. This is constructed from 1/4-inch aluminum rod or tubing. Only a short piece less than 14 inches long is needed for the construction of one antenna.

Other materials recommended in the article were some fasteners to hold the elements in place and an insulating rod to insulate the driven element from the boom. A bracket needs to be constructed out of a small scrap of aluminum to hold an "N"-type female coaxial connector. To this bracket and connector a 1/4-wavelength coax balun is attached which in turn makes connection to the 1/8-inch "T" part of the antenna feed system.

The feed system of the antenna is attached to 1/2-inch insulating standoffs bolted to the bottom bolt holes of the "N" connector. The connector and its mounting bracket are positioned on the boom so as to place the ends of the standoffs and the attached 1/8-inch "T" rods over the center

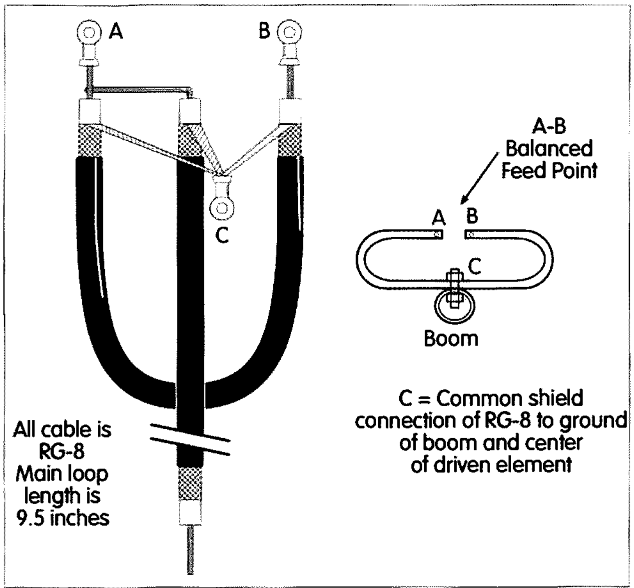


Fig. 1. RG-8U coax balun for 432 MHz is 9.5 inches long, converts 50Ω unbalanced to high-Z balanced configuration.

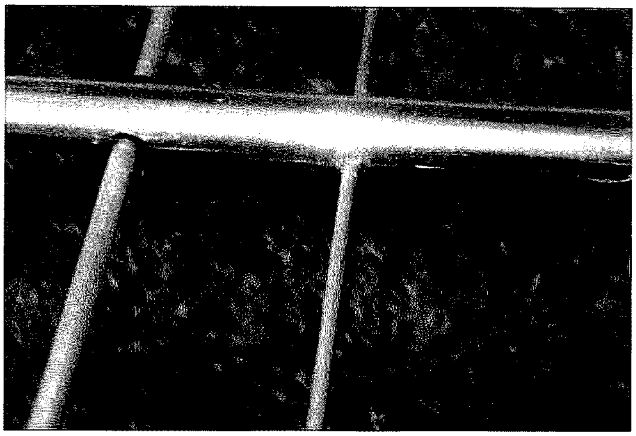


Photo A. *Close-up of new antenna construction showing black-insulated driven element and lighter color (silver) Auveco push-on retainer for smaller driven one.*

of the 1/4-inch driven element. The ends of the 1/8-inch rods are pounded flat to accept a 6/32 screw to attach them to the standoffs. The far ends of the 1/8-inch rods are held in place with a strap made from 1/4-inch-wide thin aluminum bent over to the elements and held in place with the 6/32 screws.

The RG-8 coax feed is fitted with a balun of 1/2 wavelength of coax. To figure out how long 1/2 wavelength is, divide your desired frequency into 300. That is, 300/432 = wavelength in meters, or in this case, .694444 (or more commonly, 70 centimeters) for one wavelength. Divide 70 cm/2 = 35 cm. At 2.54 cm per inch, 35/2.54= 13.77 inches multiplied by the velocity factor of coax (.69) = 1/2 wavelength of coax for our balun 9.5 inches long (see **Fig. 1**).

Wow! Lots of things to accomplish in the construction of this 432 MHz 10-element beam, and we haven't even started to drill holes. Let's look at the assembly of the components and examine the process. I started out to locate a source of 1-inch aluminum thin wall tubing and small-diameter material suitable for the element construction. On my first telephone call, I was able to locate tubing in 12-foot lengths of 7/8-inch material for $7. There was no stock of small-diameter tubing at this source, so I had to make other calls to attempt to locate the material for the elements.

I was trying to keep the materials sourcing in my local area in order to limit excessive mileage costs from picking up all the components needed. I felt that since I lived in a reasonably large manufacturing area spotted with hi-tech materials suppliers, such supplies should not be too hard to find. However, locating small-diameter tubing proved to be difficult. I was able to locate 1/4-inch and 3/16-inch solid aluminum rod at one dealer, but finally ended up purchasing 1/8-inch solid rod at another. All material was in 12-foot lengths. Total cost for the small diameter rod, $8.25.

Materials still on the shopping list included insulating bushings for the driven element; hold-down fasteners for the elements; small bits and pieces like nuts and bolts; and a "U"-bolt bracket to hold the antenna boom to the mast pipe. And, we still needed to construct a coaxial balun 1/2-wavelength long.

Well, according to documentation on this antenna which was reprinted in *The ARRL Handbook* from the original old *Ham Radio Magazine*, the fasteners for the elements could be obtained at any well stocked hardware store. They were made by Auveco Products. *However*, if I had known all along what I know now—that Au-ve-co stands for Automotive Vehicle (products) Company—my search for the fasteners would have been made more than a little bit easier.

I called hardware wholesalers and came up blank trying to find these fasteners. They are similar to the push-on retaining nuts used in the construction of a child's wagon, except that they do not incorporate the hood of the jam nut. The desired fasteners are like a shakeproof washer that has

internal fingers bent out in a cone shape of a particular diameter. This cone shape enables these washers to be slipped over a rod to firmly grasp it in position. Each element is then centered between two such devices to become locked in place (see **Photo A**).

Not only was I unable to locate the fasteners, but I also couldn't find anyone who thought I was sane. The largest hardware stores, in business for some 100 years, didn't know what I was talking about. If they didn't know, I was in trouble. Well, somewhere in my travels I had learned that these fasteners were not part of the normal nut and bolt trade but were instead automotive in nature. My first phone call to a large automotive parts warehouse landed me the phone number of a specialty nut and bolt firm, not listed in the Yellow Pages, that was located in another city and stocked automotive hardware. One call to them put me in touch with reality—they had stock of quite a number of Auveco fasteners.

Unfortunately, amidst all the excitement of getting ready to take my trip over there, I forgot to bring along samples of the elements and the diameters I needed to deal with. So just to be safe (and especially since I'd had to take time off from work to go to this place to begin with), I decided to ensure the success of the project by purchasing a small stockpile of fasteners in various sizes. Cost, $28. I most certainly overbought and will have these fasteners around for some time. I just wanted to cover all the bases.

This "run for the fasteners" trip took my memory cells back to the very early days when we used (steel) electrical conduit for boom material. The elements were 1/8-inch brass brazing rods and the method of attachment was simpler. We drilled a slightly undersized hole in the boom and then shoved the brazing rod through it, making a tight fit. Then, we drilled a second hole offset 90 degrees through the top of the boom for insertion of a sheet metal screw slightly off center from the brazing rod element. The sheet metal screw secured the brazing rod by jamming its threads along the side.

Electrical conduit (steel) for boom material was very inexpensive ($1/10 feet). Brass brazing rod or even aluminum clothesline solid wire could be used for elements. I used brass brazing rod 1/8-inch in diameter. If I remember correctly, the brass rod was a little short for 2-meter elements and I had to solder on some small-diameter tubing to lengthen them. However, for 220 and 432 MHz these smaller elements allow simple construction. Because this was to be a very economical beam antenna (costs held to a minimum), construction techniques were dictated by the materials on hand. Jamming sheet metal screws to hold elements tight to the boom will eventually result in rust, but the method works and will last quite a long time.

The rusty connection will not disturb basic antenna operation but will in time become a simple diode. This diode in many cases

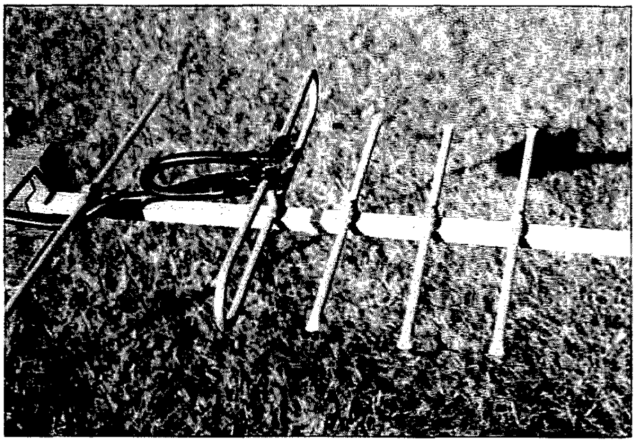


***Photo B.** Repaired 432 MHz beam antenna with balun attached. Antenna with broken elements was purchased at a swap meet for $1.*

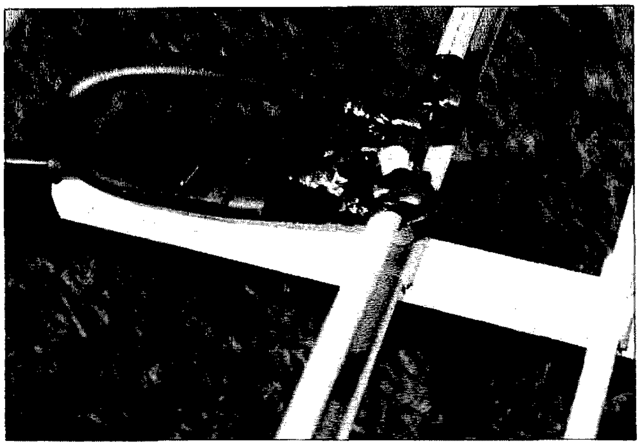


***Photo C.** Close-up of new balun assembly for salvaged antenna, constructed from 9 inches of RG-8 coax.*

will actually become a very good mixer. When joined with some metal (the elements), it allows two transmitters to mix together to produce an interference product. While the product is not very strong, it is capable of being detected by the very sensitive receivers we use for communications today. The modulation that is passed is usually that of the capturing (strongest) signal being mixed.

This mix product can be sufficiently strong to be received quite a distance from the mixing device. The only cure is to remove the rust (mixer) or to bond the metal together to eliminate the rusty connection.

I once came across an example of this in the commercial realm, involving a city emergency frequency and a radio taxi company's commercial one. The problem went unnoticed for many years because at that time mobile transmitters were not left on all the time but instead were activated only when needed. Because the offending transmitters both need to be on the air to observe the mix products, it took quite a bit of air time to discover just what signals were mixing. The mixing culprit in this case turned out to be a city water tower that was assembled with nut-and-bolt construction.

Now, these bolts were quite large and over the many years since construction had become rusty and painted over. This condition made the water tower a better transmitter at VHF than some conventional low-power transmitters. Turning on both transmitters and DFing to the water tower on the interference product became simple. The solution to this perplexing problem was to weld the bolts themselves to the metal water tower structure. Amateur locations can be just as susceptible to this type of problem as commercial radio sites are.

Well, what conclusion did I reach from trying to build a beam antenna and from all the effort needed for home construction? Being a junk box addict, I still opt to construct my own antennas when possible, but I will temper the construction methods used and not go every time for the ideal components to use.

The up side of this whole construction affair was that my partner in electronics experimentation Kerry N6IZW had picked up a small 400 MHz beam at a swap meet for $1 (see **Photo B**). It was missing the driven element and matching section, but I constructed a balun from a short section of RG-8 (**Photo C**) and replaced the broken element with some scrap aluminum. Testing the antenna showed resonances at the 432 MHz SSB frequencies (1.2:1) and still a good match (1.5 to 1) up into the 440 MHz FM region.

That's it for this month. Has the newly constructed antenna functioned well? Well, no: I haven't constructed the feed arrangement yet. When it's tested, I will let you know. Is it better to purchase a small antenna or construct one? This time around, it was too time-intensive to build, so we bought used instead. Next time, who knows? 73, Chuck WB6IGP.

Build a Colloidal Silver Generator
continued from page 25

Colloidal Silver Generator Parts List	
Component	Radio Shack #
Transformer, 24V 450 mA	273-1368
Switch	275-634
AC cord	278-1255
Fuse Block	270-739
1/4 A fuse	270-1002
Bridge rectifier, DIP	278-1181
7806 regulator	276-1770
Green LED	276-022
Neon lamp	272-707
1,000 µF 50 V capacitor	272-1047
270 Ω resistor	271-1314
Plastic box	270-224
Binder post jacks	274-661
Fine (.999) silver is available from Holtzer & Miller Co., (800) 462-7747	
Bare circuit boards are available from FAR Circuits, 18N640 Field Court, Dundee IL 60118, (847) 836-9148	
Parts kits, silver electrodes, and assembled and tested circuits are available—contact the author for details	

Laser Backscatter Tester Parts List	
Component	Radio Shack #
741 op amp	276-007
10 k pot	271-282
.1 µF capacitor	272-1069
.01 µF capacitor	272-1065
Switch, double pole	275-636
Battery snaps	270-324
Solar cell*	276-124
Plastic box	270-224
0-1 mA meter**	270-1754
680 kΩ resistor***	N.A.
*The plastic bubble used to package the solar cell is used for the sample tray.	
**This meter is marked "0-15 VDC" but includes an external 15 k resistor. DO NOT use the external resistor.	
***Radio Shack does not carry a 680 k resistor. It is available from other sources, or connect a 470 k and a 220 k in series.	
Visible diode LASER module is available from M.P. Jones & Associates, Inc., (800) 652-6733. The part number is 6996-LZ.	

Disclaimer

As an ebonics-speaking friend of mine might say, "I don't want no f— trouble from de mf— FDA." This is mostly an electronics-oriented journal, so If someone you know wants to mess around with silver (or other metal) colloids, and is too ignorant to hook three little batteries together to make 'em, you can probably help them by building this simple circuit.

The alternative health-care ("this is a food supplement, not a medicine") field is no more honest than our commercial medical industry—it just isn't backed with the strong arm (a.k.a. swat teams) of the law, as enforced by the FBI, FDA, NIH, WHO, and so on through the Washington alphabet.

With the exception of a warning by Dr. William Douglass in his Second Opinion *newsletter, everything else I've read has encouraged people to take silver colloids internally. Douglass, whom I respect, even though he doesn't answer his mail, says silver is a dangerous toxic metal. If there are any studies which show silver to be toxic, I haven't seen them referenced yet—maybe you can research this and let me know.*

Meanwhile, I am not recommending that you chugalug silver colloids, nor is the author of the article. If you do it and find wonderful health benefits, that's your decision. If you swallow the stuff and your teeth turn black, I don't want to hear any whining. If it kills you, well, we all have to go sometime, right?

I'm working on a booklet on how to make and use silver colloids, so I'd appreciate anything you can find about using it, pro and con. This is yet another case of where, despite a bunch of evidence supporting the value of silver colloids, the medical industry has refused (as far as I've been able to find out) to research their potential—presumably because the results could not be patented and sold for egregious profits...Wayne.

NEVER SAY DIE
Continued from page 63

keeps meat put in a pyramid-shaped container from rotting and which also sharpens razor blades. If the effect is a delusion, then it is able to delude an electron microscope. Check page 176ff for details. Okay, smarty, how can a small cardboard or Plexiglas pyramid sharpen a razor blade or mummify meat?

The normal scientific approach is to declare that all researchers claiming such an unexplainable effect have made errors.

So how about dowsing? Thousands of years of dowsing studies are all flawed, right? Sure.

Then we have the work of Wilhelm Reich and his orgone generators. Our beloved government put Reich in prison (where he kind of died) and destroyed his laboratory and orgone generators. A friend of mine, Dr. Charles Dockum, with whom I worked on a Guggenheim Grant project for the Guggenheim Museum on Fifth Avenue, built

Continued on page 83

Number 82 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

New technology

With all the recent comings and goings in the amateur radio market, it's exciting to be able to talk about one of the most innovative technologies to come down the pike in years.

We are all familiar with the common types of modulation forms in use to transmit radioteletype over the air. The classic, most common, method is frequency shift keying, of course, with a MARK and SPACE signal used to represent the two states of the RTTY loop. With the traditional method of encoding Baudot five-level code at 60 words per minute, or 45.45 bauds, each pulse lasts 22 mSec, and has a square waveshape.

It has come to my attention that cutting-edge amateurs have been able to impress a second digital signal on the flat top of each 22 mSec pulse. This allows a phase shifting signal to ride on top of the amplitude modulation of the radioteletype signal. The utility of this quickly becomes obvious when a logarithmic form of encoding is used, with inversion of the impressed amplitude on the wave top.

A practical application currently under investigation allows a computer-linked, object-oriented graphic to be fixed in linkage to the frequency-shift-keyed signal. By splitting this object off during reception, real-time graphics are now possible over a low-bandwidth, 45.45-baud signal.

I look forward to being able to tell you more about this technology, officially called the Amplitude/Phase Ratio, Inverse Log, Fixed-Object-Oriented Linked System, within the next several months. Stay tuned!

On a more direct note

Hugh Phillips K7XM writes that he is looking for a good standalone RTTY program to use with his (late) AEA PK-232. Well, Hugh, several programs, including LanLink, PakTerm, and PaketPet all come to mind. Each has its own flavor, and each its advocates and critics. But that's, as I tell my children, why Baskin-Robbins has 31 flavors. Check out the various programs available in the RTTY Loop Software Collection—I'll remind you how later—and see if one, or more, doesn't suit your fancy.

Another message from T. John Lewis VE3LGS, addresses the problem of the ham not living in the United States. He says: "I have been an avid reader of RTTY Loop for many years but in the past few have gotten away from real RTTY to the 'fad' modes. I would like to get back on RTTY. I have several TUs just gathering dust which work perfectly. I see that you have a program called AUTORT on a disk you mail out to persons who send an SASE and US$ to you by mail. Since it is impossible to get US stamps here in Canada without driving to the USA, I wonder if there is another easier way. Is there an Internet address where it can be downloaded?"

John, although I have been trying to get a number of programs up "live" on the RTTY Loop home page, space considerations prevent me from having them all on-line at the same time. After all, there are more than 20 Mb of programs and data, quite a bit more than the space allotted by my Internet Service Provider. I understand the problem, though, of folks who may want just one program, or who have problems with stamps or mailers. If you need just one program, I can attach it to an E-mail reply, presuming you can download binary files from the Web. If you only have a text service, such as some of the "freemail" servers, you may not be able to retrieve such files. They are a bit long to UUENCODE, so getting a disk the old-fashioned way may be your only solution at that point. If you have a question, drop me a line. Let's talk.

As the communication wave spreads out from the Internet, there is bound to be some confusion among those not familiar with amateur radio. I received the following questions, which I have massaged a bit for the purposes of generality, and present them here, with answers. Maybe one or two of these will help you in discussing digital matters with friends and coworkers.

> *"This new technology is officially called the Amplitude/Phase Ratio, Inverse Log, Fixed-Object-Oriented Linked System..."*

Q. Is there a way of accessing some of the ham resources on AOL and CompuServe if you have another Internet service provider? AOL and CompuServe are only available overseas through an expensive phone call.

A. While both AOL and CompuServe are normally accessed via their own telephone networks, both can now be accessed by subscribers via the Internet as well. I would advise checking the Internet home pages of each service (http://www.aol.com and http://www.compuserve.com, respectively) to look into these options. Offhand, I don't see why Internet access should not be available to non-USA users.

Q. I am about to retire and go sailing. While I am practicing my Morse code and may succeed in getting an amateur license before I leave, may I operate an SSB radio aboard ship while yet unlicensed?

A. Not on amateur bands, you can't! Get that ticket first!

Q. May I operate an amateur radio aboard the boat while unlicensed using only those frequencies which have been allocated for marine SSB telephony?

A. Amateur is amateur and marine is marine. One has nothing to do with the other. If you want to operate on amateur frequencies, you need an amateur license.

The bottom line is not to confuse the two services. The radios may look alike, and the signals may sound alike, but they are different animals.

And finally, I received a question about a PK-80 given to a ham who did not pass along his name. He wondered if this unit, originally designed for the Radio Shack TRS-80, would work with a current PC-type computer. You know what? I don't know! As I recall, the PK-80 was a simple interface, which depended on software programming to perform the digital conversions. Offhand, I don't see why, with suitable software, the PK-80 wouldn't work with a PC. I look forward to reader input on this one.

I mentioned the RTTY Loop Software Collection. This sixteen-disk (as of this writing) collection of RTTY software and utilities features a wide variety of programs of interest to digital amateur. On-line amateurs can check out the list on the RTTY Loop home page at http://www2.ari.net/ajr/rtty/. If you cannot connect, a self-addressed stamped envelope to the post office box above will get you a printed listing. Either way will fill you in on the details of how to obtain any of the disks of the collection. I welcome your comments, questions, suggestions, and critiques at the P.O. box, or via E-mail at ajr@ari.net.

Next month, I'll try to pry my tongue out of my cheek, or have you not understood the opening paragraphs yet?

Continued from page 81

a small orgone generator and used it to cure a wide range of illnesses for friends. They're very easy to build, by the way.

More hokum? Or anomalies worthy of investigation?

The government certainly isn't going to fund research into weirdom like this, nor are any large corporations, so that leaves it up to independent researchers. And since there are no experts in these fields, researchers are going to be amateurs, not professional scientists. But then, virtually every major new discovery in science has been made by an amateur, and all have been ridiculed and humiliated by the scientific elite (a.k.a. prestigious scientists) every inch of the way.

Another Gloom & Doomer

The Survival of Civilization by John Hamaker. Hamaker-Weaver Publishing, R1 B158, Seymour MO 65746; ISBN 0-941-55000-1, 1982, 218pp, $12. Hamaker is all upset over the rapid increase in CO_2 levels, predicting the end of the world. I want a second opinion. But he does make a good case for remineralizing the earth. A very good case. Ever since listening to the Dr. Wallach *Dead Doctors Don't Lie* tape, I've been looking for more information on the loss of minerals from our topsoil.

As Hamaker points out, to look at them you can't tell the difference between crops grown using NPK (chemical) fertilizers and remineralized crops, but one is healthy and the other sure isn't. So what's remineralization? This has to do with grinding up rocks to replace the minerals which have either been leached out of the soil, plus the minerals plants have extracted and which have not been returned. Once the farms were "played out" the farmers had to start using commercial fertilizers to keep their crops growing. The problem is that this robs us of the minerals our bodies need to keep healthy.

How effective is remineralizing the soil? The USDA ran a test with seven steers fed the usual fodder and another seven fed the exact same diet with 3.5% cement kiln dust added. The dust-fed animals gained 28% more weight and ate 21% less feed. Imagine how healthy you and your family might be if you were getting all the minerals your body was designed to use, but which you haven't been getting in your supermarket food!

The Federalist Papers

John Jay wrote that "Nations in general will make war whenever they have a prospect of getting anything by it." Pacifists should face up to that reality. Wars are prevented by making it too dangerous for others to attack you. Weakness produces subjugation, not peace. Our forefathers had no illusions about people. Madison wrote, "Enlightened statesmen will not always be at the helm." Amen! The Constitution was designed to take that into account and limit the damage that foolish leaders could do. When the Constitution is observed, it works pretty well. When federal judges ignore the Constitution or get particularly creative in interpreting it, we sure get into a heap of trouble. (My thanks to Thomas Sowell for bringing up the subject.)

History has continually confirmed John Jay's observation. As much as pacifists hate the idea, history has shown that strength is the best guarantor of peace, not unilateral disarmament—but can you think of any peace movements which have operated on this principle?

The idea, unsupported by history, that if people get to know one another they won't fight, has been kicking around peace movements for ages. So how come the Hutus in Rwanda were so easily incited to murder around 800,000 of their erstwhile friends and neighbors, the Tutsis? And just a couple of generations ago the Germans were able to wipe out millions of Jews and Gypsies? And so on.

So let's smile and be friendly Americans, but carry a big stick, to coin a phrase.

Sharks!

While in Aspen skiing, in January, Sherry bought some books at a secondhand store. One of them was a book that I've been wanting to buy for some time, *Sharks Don't Get Cancer* by Dr. Wm. Lane; Avery Publishing, 1993; 192pp; ISBN 0-895-29520-2; $12. Lane makes a very convincing case for shark cartilage being able to cure just about any cancer, as well as arthritis, psoriasis and macular degeneration.

As with other non-pharmaceutical remedies, the medical industry has been fighting this as quackery. Lane points out how reactionary the industry is. Despite endless claims for the Heimlich maneuver for choking victims, the American Red Cross refused to accept it for ten years, continuing to endorse back-slapping, which causes a stuck object to be even tighter stuck in the throat.

The money in the trillion-dollar medical industry (the most profitable industry in the US) is in drugs which can be patented, so if an illness isn't to be cured with a drug, there's no organization to research the proposed cure. Well, you ask, how about the National Cancer Institute? Surely they'll check out any proposed cancer cure, right? Wrongo. It turns out that the NCI "does not deal in cures for cancer, but only in the mechanisms of cancer." Maybe that helps to explain why so many reported cancer cures have been completely ignored by the NCI. And since about 50% of us are going to have a personal brush with cancer at some time in our lives, maybe we need to better educate ourselves and depend less religiously on our doctors.

Shark cartilage isn't patentable, so there's no pharmaceutical company to pony up the $231 million it costs to get a new drug okayed by the FDA, so you'll have to buy the stuff in health food stores as a dietary supplement.

But first, for heaven's sake read the book. It could save your life. Or, better yet, wait until you are almost dead from cancer or crippled with arthritis and *then* spend the $12.

ZL Media Flurry

When the results of an international test showed their students placing 14th in the world, the New Zealand media raised quite a fuss. But when American students placed 14 places below that, our media just ignored the matter. As the costs of communications and transportation keep dropping, much better educated workers in other countries are, more and more, going to be replacing American workers.

If you are an employer you know what I'm talking about. Finding educated workers with any motivation is getting to be almost impossible.

The bottom line is that your children are not going to get a decent education in a public school. At the very least you should be doing some home schooling to make up for this sorry situation, which is being vigorously protected by the teachers' unions.

Privacy Please

If someone is interested in assuming your identity all they have to do is get your name, current address, Social Security number, your previous address, your mother's maiden name, your birth date, and so on. This is all now available from Lexis-Nexis (Box 933, Dayton OH 45401) via their P-Trax data base. Yes, you can protect yourself. Call 888-965-3947 and request that your name be deleted. They'll tell you how to request the deletion in writing. If the wait is too long on the above number you can try 800-543-6862 and contact Andrew Bleh (blay) at extension 3385. His manager is Bill Fister at extension 1365.

Let me know how you make out.

Self-Abusers

Sherry pointed out that virtually all of the troubles I've had with employees stealing or causing me other serious problems has been from self-abusers. Smokers and alcoholics, who don't care enough to take care of themselves, are not likely to be good employees. This is a pretty good rule.

State of the Art

In late January I got a call from Art Bell W6OBB asking if I was game to appear on his talk show again. Sure. I knew what I was getting myself into, but the end seemed to justify the means. We talked for five hours, from 2 to 7 a.m. Eastern time. We started out talking about amateur radio and then wandered into cold fusion, my theories on aliens, how to make money, my list of books you're crazy if you don't read, the Bioelectrifier, silver colloids, and then more amateur radio. By the end of the day we'd had over a thousand phone calls asking for more information. These tapered off over the next few days, but then the mail began to pour in, if you call 300-400 letters a day a

Continued on page 84

FCC FCC Issues Issues

Imagine using your newly issued amateur radio callsign on the air, only to find out that someone else also has the same callsign! Of course, that's not supposed to happen. But it did, to at least a handful of newly licensed hams in the southeast US. The FCC blames the callsign snafu on computer problems.

The foul-ups started happening in mid-October. That's when the FCC issued the same callsign to several people who had just passed their license tests. Louise Williams KF4MTE of Newberry SC is a case in point. She was assigned KF4MTO on October 23rd—that same callsign wound up being issued seven days later to another woman in North Carolina. Two days after that, on November 2nd, KF4MTO was again assigned, this time to a woman in Tennessee. At least two other South Carolina hams had similar experiences.

The Commission was having computer problems for about a week, just before Gate 2 vanity callsigns were issued. A spokesman said he has no idea how many licenses may have been issued to more than one person. It's possible that there might be more hams who are unaware that they are operating with a license holding the wrong callsign. But the Commission's database has been corrected so that there are no callsigns with more than one holder. In the case of more than one person getting the same callsign, the last person to be assigned the callsign got to keep it.

An FCC spokesman says it appears that the problem of multiple people issued the same callsign is apparently limited to first-time licensees only.

Thanks to South Jersey Radio Assn. *Harmonics*, January 1997, which got it from *ARRL Electronic Letter & Newsline, Inc.*

Revamping of Emergency Broadcast System

The Emergency Broadcast System, or EBS, will soon give way to the Emergency Activation System, or EAS. The current EBS was instituted under President Kennedy in 1963 as a way of using telecommunications to alert the public to an emergency. This was a year after the Cuban missile crisis and its original intent was to allow the president to address the nation at a moment's notice in an emergency. Currently, stations put a test pattern or tone on the air and then announce that a test is under way. An eight-second, one-kilohertz tone signal follows. Finally, the audience is told that in the event of an actual emergency they would be given Civil Defense Instructions.

The current EBS relies on a daisy-chain notification system, where one station receives the warning and then sends it on to the next station. That means if one station's equipment fails, others may not get the warning. The new Emergency Activation System depends more heavily on an approach similar to the World Wide Web. In the new system no station relies on just one source to receive the broadcast warnings. Rather, digitally encoded signals will activate computers at radio and TV stations and download emergency warnings.

From the January 1997 *PARKing Ticket.*

FCC Web Site

The FCC's Office of Public Affairs recently announced the establishment of a new page on the Commission's Internet Web site that will provide worldwide access via the Internet to live and recorded audio broadcasts of selected FCC events. The Commission began by broadcasting its December (1996) meeting through a RealAudio link on the FCC's home page. This site will also include a schedule of events, a comment form and an E-mail address to solicit ideas on how to improve or add to its usability. The site is http://www.fcc.gov/realaudio/.

TNX Rick KB7UFZ, "Odds 'N' Ends," *Maple Valley Hamlink*, January 1997.

RE: Insurance Claim #KNEBSO4GON

I am writing in response to your request for additional information.

In Block No. 3 of the accident report form, I put "poor planning" as the cause of the accident. You said in your letter that I should explain more fully, and I trust that the following details will be sufficient.

I am an amateur radio operator. On the day of the accident, I was working alone on the top section of my new 80-foot antenna tower. When I had completed the work, I discovered that I had, over the course of several trips up the tower, brought up about 300 lbs of tools and spare hardware. Rather than carry the now unneeded tools and material down by hand, I decided to lower the items in a small barrel by using a pulley which, fortunately, was attached to the top of the tower.

Securing the rope at ground level, I went to the top of the tower and loaded the tools and materials into the barrel. Then I went back to the ground and untied the rope, holding it tightly to ensure a slow descent of the 300 lbs. of tools. You will note in Block No. 11 of the accident form that I weigh 155 lbs. Surprised at being suddenly yanked off the ground, I lost my presence of mind and forgot to let go of the rope. Needless to say, I proceeded at a rather rapid rate up the side of the tower. In the vicinity of the 40-foot level, I met the barrel coming down. This explains my fractured skull and broken collarbone. Slowed only slightly, I continued my rapid ascent, not stopping until the fingers of my right hand were two knuckles deep into the pulley.

Fortunately, by this time I had regained my presence of mind and was able to hold tightly to the rope in spite of my pain. At approximately the same time, however, the barrel hit the ground and the bottom fell out of it. Without the tools, the barrel now weighed 20 lbs.

I refer you again to my weight in Block No. 11. As you might imagine, I began an abrupt descent down the side of the tower. Around the 40-foot level, I met the barrel coming up. This accounts for the two fractured ankles and the lacerations of my legs and lower body. The encounter with the barrel slowed me enough to lessen my injuries when I fell onto the pile of tools, and fortunately only three vertebrae were cracked. I am sorry to report, however, that as I lay there on the tools, in pain, unable to stand, and watching the empty barrel 80 ft. above me, I again lost my presence of mind. I let go of the rope.

TNX, *ARNS Bulletin*, February 1997, with additional TNX to *RadioActive*Notes.*

70 Cm Band Loss in Guatemala

Hams have lost out to commercial users of the 70 cm band in Guatemala, and the cost could be interference to ham radio satellite operations worldwide. This is because Guatemala now intends to put commercial operations across the band—commercial signals that will probably include the 70 cm satellite subband.

Manfred Kolbe TG9IKE reports via the *AMSAT News Service* that on Monday, November 18, 1996, the *Diario de Centro America* published the new law regulating all telecommunications in Guatemala. Part of the law removes ham radio access from all frequencies above 146 MHz except for tiny slivers in the gigahertz region.

The new law was created by a commission from the state-owned telecommunications company GUATEL, which consulted the Radio Club of Guatemala about the project. The commission was quite astonished to learn that ham operators operate some 20 satellites for global communications, and even more so when Guatemalan hams supplied a list of amateur satellites with operating frequencies and modes. The existence of the Amateur Satellite Service was also brought to the attention of the CEO of GUATEL. Also told was the chairman of the committee of Congress in charge of the new Guatemalan telecommunications law. He was even presented IARU and ITU documentation.

But even with all of this documentation, the decision was made to run the hams off and turn the spectrum over to moneymaking operations. As a result, the 70 cm band in Guatemala, which is composed of the frequencies between 430 to 440 MHz has now been declared available for commercial use only.

And it's not only Guatemalan hams who will face problems because of the change. There is likely to be heavy interference to Amateur Satellite Service operations in Region 2 when the transponders on various hamsats pick up commercial signals and rebroadcast them on other bands. Even for low orbiting satellites this will affect an area in southern Canada, all of the USA, Mexico, Central and South America down to Chile and Argentina. Taking into account the future operations of the Phase 3D ham satellite, the situation may even get a lot worse.

Lifted from *SARA* (Socorro Amateur Radio Assn.) *News*, January 1997, with TNX to *Newsline Radio*, CBBS Edition #1008, 12/6/96.

NEVER SAY DIE
Continued from page 83

pour. Since I had to open and answer them all, it was a pour for me.

But why am I the only one out there getting on talk radio and promoting amateur radio? There are thousands of talk shows and you're just sitting there like a lump on a stump, not doing your bit. Look, the ARRL has shown pretty clearly that *they're* not going to do anything to help get the public interested in amateur radio. The few promotions I've seen have been feel-good stuff for hams, not information for the public. The public doesn't remember a lot of what CB is,

much less has ever heard of ham radio.

Yes, I know all the excuses. Rationalizations to explain why nothing is being done. Sure, kids are into the Internet. They're into computer games. Yatata yatata. Kids have always been interested in lots of things, but that didn't stop them from getting hooked on ham radio. I somehow managed to get involved with hamming even though I was also involved with dating, roller skating, reading books, photography (I spent endless hours in the school darkroom), singing (with the St. Paul's choristers, the Erasmus Hall Choral Club, and the Philharmonic Choir of Brooklyn), seeing every movie that came out, the Boy Scouts, and so on.

In high school I not only rehearsed every day with the Choral Club, I belonged to the Savoyards, where we put on Gilbert & Sullivan operettas, the book club, the camera club, and the radio club. I had plenty to do without amateur radio, but there I was, busily putting together ham and audio equipment in my workshop. I did that for years.

So don't whine to me about how kids are too busy today for amateur radio. What we need is a selling job. We're not pushing the product, so we're going to go out of business. You can't sell any product unless the public knows about it. That means visibility. National and local visibility. Are your ham club meetings announced in the local papers and on the community radio and TV announcements? How about posters in the local schools? On any local bulletin boards. On the Internet, for that matter? In Peterborough the local A&P has a bulletin board near the store exit.

How about getting after your ARRL director to get the League to do some national promotion? When is the last time you saw a story about the fun and adventure of amateur radio in a national magazine? Or a local paper, for that matter? Yes, I know, I'm repeating myself. Well, I *have* to, since you haven't done anything to make things change. And I'm going to keep after you to lean on the directors, to do all of the promotion you can locally, and to get your more talkative members into your local schools to acquaint the 5th graders with what we have to offer. Otherwise you're going to have to make do with CB fallout. That what you want?

Plenty of big organizations have blundered themselves out of business, so the ARRL could easily be blown away. The National Computer Congress ran the biggest show in the computer industry, often drawing around 100,000 attendees, packing New York, Las Vegas, Dallas, Atlanta and Chicago hotels. But they ignored the personal computer and were wiped out.

We need to get millions of kids interested in high-tech careers, and amateur radio is one of the easiest ways of doing that—but only if they're made aware that the hobby exists.

The people writing to me are subscribing to *73*, but they also want to know what books I can recommend they read to understand the fundamentals of electricity and radio. I've asked you to let me know which are the best books you've found so I can let them know. I haven't heard from you yet. Tsk.

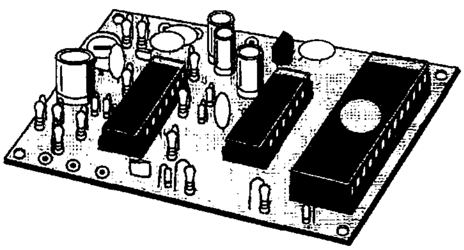
Parenting

The most important skill we can build is in parenting. The one mark most of us leave behind is our children. Unfortunately, the parenting skill is no more intuitive than any other. And since this is probably the most important thing you're going to do in your life, the more you can learn about this skill the better. After all, when you make mistakes with your kids you are usually making permanent mistakes which will to some degree cripple them, or at least rob them of their full potential.

The cover feature on the February 3, 1997, edition of *Time*

Continued on page 88

New Products



New Hamtronics CWID Module

Ever since Hamtronics, Inc., introduced its slick low-power CMOS COR-4 module several years ago, customers have asked if they could get just the CWID part of the unit. They had different applications in mind: not just amateur repeaters, but beacon stations, commercial and public safety 2-way radio base stations, broadcast satellite uplinks—and so on.

Here it is: The new CWID-2 module features small size, ease of assembly and maintenance, versatility, and a thorough manual which describes how to take advantage of all the available options.

The CWID-2 uses all CMOS logic and operates on 7-15V at only 3 mA. It's easy to fit into existing enclosures because it's only 1-3/4 x 3-1/8 inches. The factory-programmed EPROM saves assembly time and allows longer messages than did their earlier diode-matrix type CWID module—up to 200 characters. The CWID-2 can also be set to repeat a message continuously for beacon operation.

For more details, write Hamtronics, Inc., 65-F Moul Road, Hilton NY 14468-9535. Phone (716) 392-9430 or FAX (716) 392-9420 and ask for a complete catalog.

Stop That Interference!

Don't let strong radio signals ruin the game (or sitcom, or soap) for you. Use the MFJ-711 high pass TVI filter between your cable and VCR or TV and wipe out TVI coming from broadcast, commercial, two-way, amateur and CB radios operating below 30 MHz.

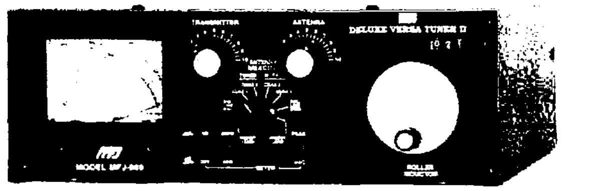
The MFJ-711 is protected by MFJ's famous "No Matter What™" one-year unconditional warranty, and it's only $24.95! See your dealer, or contact MFJ Enterprises, Inc., at 300 Industrial Park Road, Starkville MS 39759; phone (601) 323-5869 or FAX (601) 323-6551; order by calling toll-free (800) 647-1800.

It's a perfect gift for anyone who's tired of watching a messy TV screen—think Father's or Mother's Day—so use your highlighter and leave this copy of *73* in a prominent place!

191 AM Radio Log

The National Radio Club's 17th edition of their AM Radio Log is now available. Its 312 pages list the US and Canadian AM broadcast stations by frequency from 530-1660 kHz, with a cross reference by call letters and city. The listing includes the call, address, format, networks, phone, day and night powers, antenna, time zone, and slogans. With 191 listed stations on 1230 kHz, a person could make a career out of logging everything on one frequency. The list comes on 8-1/2" x 11" paper, punched for a binder. The club also has lists available of Latin American, European, and all other stations. Box 164, Mannsville NY 13661.

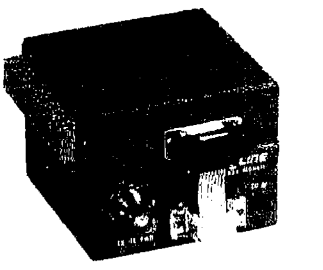
Absolute Minimum SWR



MFJ presents the world's only 300W AirCore™ roller inductor antenna tuner—the MFJ-969! It has all the great features of the MFJ-949E, plus the widest matching range of any full-featured antenna tuner and continuous 6m through 160m coverage. MFJ's AirCore roller inductor, a three-digit turns counter and spinner knob gives owners of the MFJ-969 exact inductance control; you get absolute minimum SWR, something you just can't get with a tapped inductor.

MFJ's QRM-Free Pre-Tune™ lets you pre-tune your MFJ-969 off the air into a built-in dummy load without causing QRM, making your actual antenna tuning faster and easier. There are scads of other features, and they all fit neatly into a scratch-proof black box less than a foot square—and it's only $179.95. For more information or the name of your nearest dealer, contact MFJ Enterprises, Inc., at 300 Industrial Park Road, Starkville MS 39759; call (601) 323-5869; FAX (601) 323-6551; visit the Web site at http://mfjenterprises.com; or order toll-free at (800) 647-1800. Check it out. Absolutely.

New Skyline-RTU

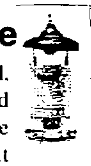


RF Neulink introduces the new Skyline-RTU synthesized VHF transceiver, designed to make remote data control reliable and simple. Each RTU is a fully integrated subsystem that includes a transceiver, RS-232 modem interface and a digital/analog I/O board, all in a 3" x 3" x 2.5" steel enclosure.

The radio modem platform is the NEULINK 9600V, a high-speed 9.6 kBps 2-watt transceiver modem. Up to 64 channels can be programmed into internal memory. With its 65,000 unique ID codes, this synthesized VHF modem can be configured for point-to-point and point-to-multipoint networks. Frequencies available are 136-174 MHz, 218-230 MHz, and 260-280 MHz.

For additional information contact RF Neulink, 7610 Miramar Rd., San Diego CA 92126. Call (800) 233-1728 or (619) 549-6340; FAX (619) 549-6345; E-mail: rfneulink@aol.com

From Russia, with Low Noise



Svetlana Electron Devices, Inc., announces its EF86/6267 audio small-signal pentode. Manufactured in St. Petersburg, Russia, it's perfect for first gain stage in phono, guitar, or microphone preamps: The voltage gain in pentode connection is greater than 400. The EF86/6267 is designed for low noise, low microphonics, and low heater-cathode hum induction.

It's internally shielded, and the solid metal shield canister improves structure rigidity—you'll find it superior to the screen shields used in older versions of EF86. To learn more about other features of the EF86/6267, contact Svetlana at 3000 Alpine Road, Portola Valley CA 94028. Phone (415) 233-0429 or FAX (415) 233-0439.

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

As this is being prepared (late January), the solar flux is still at a *very* low level (75) and there is no sign of improvement in propagation conditions that would lead to encouraging news for DXers in the immediate future. Conditions in April are likely to provide GOOD days on the 7th-10th, 14th, 15th and 22nd. POOR days are likely to be the 1st, 2nd, 18th, 19th, and 26th-29th. FAIR days are expected on the 4th, 5th and 24th. Days trending *adversely:* 11th, 12th, 17th, 25th, and 30th. Days trending *favorably:* 3rd, 6th, 13th, 20th, and 21st.

There is a possibility of very upset geophysical conditions on Earth on the 18th and 19th and the 26th through the 29th. These could be weather/atmospheric- or magnetic/ionospheric-related, or possibly combinations of these effects. As you can see, it is an interesting mix: five days trending adversely and five days trending favorably. There are seven Good days, three Fair days, and eight Poor days, so April represents an almost 50-50 split between favorable and unfavorable conditions. Therefore, you will have to keep a sharp lookout to make the best of opportunities, and continually monitor WWV at 18 minutes past any hour for the latest updates on magnetic field, ionospheric and solar flux values as they change—to either help or hinder.

10-12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15-17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the U.S.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30-40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar), as well as short-skip during hours of darkness to 1,500 miles or more.

160 meters

This band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked (G) on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

APRIL 1997

SUN	MON	TUE	WED	THU	FRI	SAT
		1 P	2 P	3 P-F	4 F	5 F
6 F-G	7 G	8 G	9 G	10 G	11 G-F	12 F-P
13 F-G	14 G	15 G	16 G-F	17 F-P	18 P-VP	19 VP-P
20 P-F	21 F-G	22 G	23 G-F	24 F	25 F-P	26 P-VP
27 VP	28 VP	29 VP-P	30 P-F			

Note: U.S.A. Daylight Savings Time begins April 6.

Number 88 on your Feedback card

HAM HELP

We are happy to provide Ham Help free on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double-spaced, on a full 8-1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully. A 1, for example, can be misread as the letters I, i, I, or even the number 7. Specifically mention that your message is for the Ham Help column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Needed: Owner's manual, schematic diagram, or service manual for a Bearcat Model BC-8 scanner. Please contact *Glenn Torres KB5AYO, 584 Central Ave., Reserve LA 70084.*

NEVER SAY DIE

Continued from page 85

had to do with educating babies. It pointed out that there are windows of opportunity for kids to develop their brains. If they don't get the right stimulus at the right time, their brains do not develop normally and never will.

When I learned to horseback ride I found that virtually every intuitive response was wrong. Ditto when I learned to ski. Well, the same goes for bringing up kids, so if you don't get busy and start reading before you get involved with the most important project of your life, you are going to do irreparable damage.

The damage—permanent damage—can start even before conception. I've a number of really great books on this subject on my list of books you're crazy if you don't read, and I'll be adding a few more. Eventually I hope to have the time to write a book on the subject, but I'm not sure there are enough people who care how their kids turn out to make it worth my time.

How early should you start reading to your child? How about before birth? Music, too. One book I recommend explains how you can teach your child over a hundred words before it is born. Will your baby have heard Beethoven's and Sibelius' symphonies a bunch of times before being born? Rock music? Not if you've read what playing it does to plant growth! Yes, there's a book I recommend on that, too.

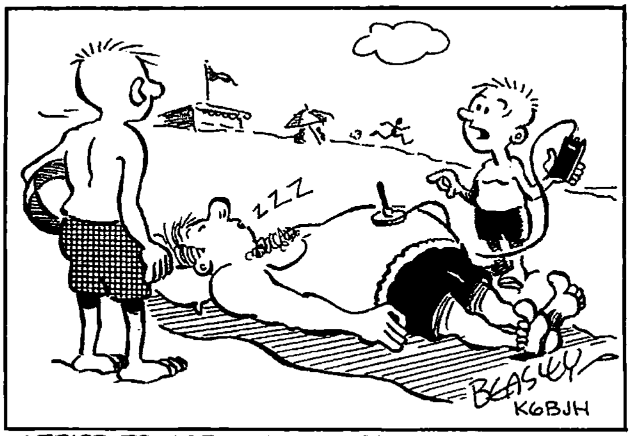
If you don't do anything to change our school system radically you're going to want to find a private school, and probably get your kid started at two or three years of age. Something like the Sudbury Valley School, with Montessori ideas thrown in.

Well, enough on that for now.

Eating It Raw

When I mentioned on the Art Bell show that I've shifted to a mostly raw food diet, and that I've found a great combo is to chop up (I use the Cuisinart) raw broccoli, cauliflower, and carrots into small crunchy bits, and then add some of my coleslaw dressing, I got a bunch of requests for the dressing recipe. In case you missed it a few months ago, it's simple and full of healthy stuff. Mostly. Take five parts plain yogurt, two parts apple cider vinegar, two parts extra-virgin olive oil, one part honey, one part light mayonnaise, salt and pepper to taste, and lace generously with celery seeds. My, it's good! It also makes a good dip for raw veggies. You can chop up cabbage and you've got coleslaw. It's a sauce, a dressing, and a dip.

73 wants your feedback... we've been improving *73* for the past months with more articles, easier reading type, etc. And honestly, we *need* your feedback (in detail) if you have any critique either for or against the subtle changes that we've made. We know we can't please everyone everytime, but if you tell us what you want *73* to be, we'll at least try to head in the direction for further "improvements" that might be most appealing to you. Thanks.



I TRIED TO USE HIM AS A PARABOLIC REFLECTOR, BUT I THINK HE'S CURVED THE WRONG WAY !!

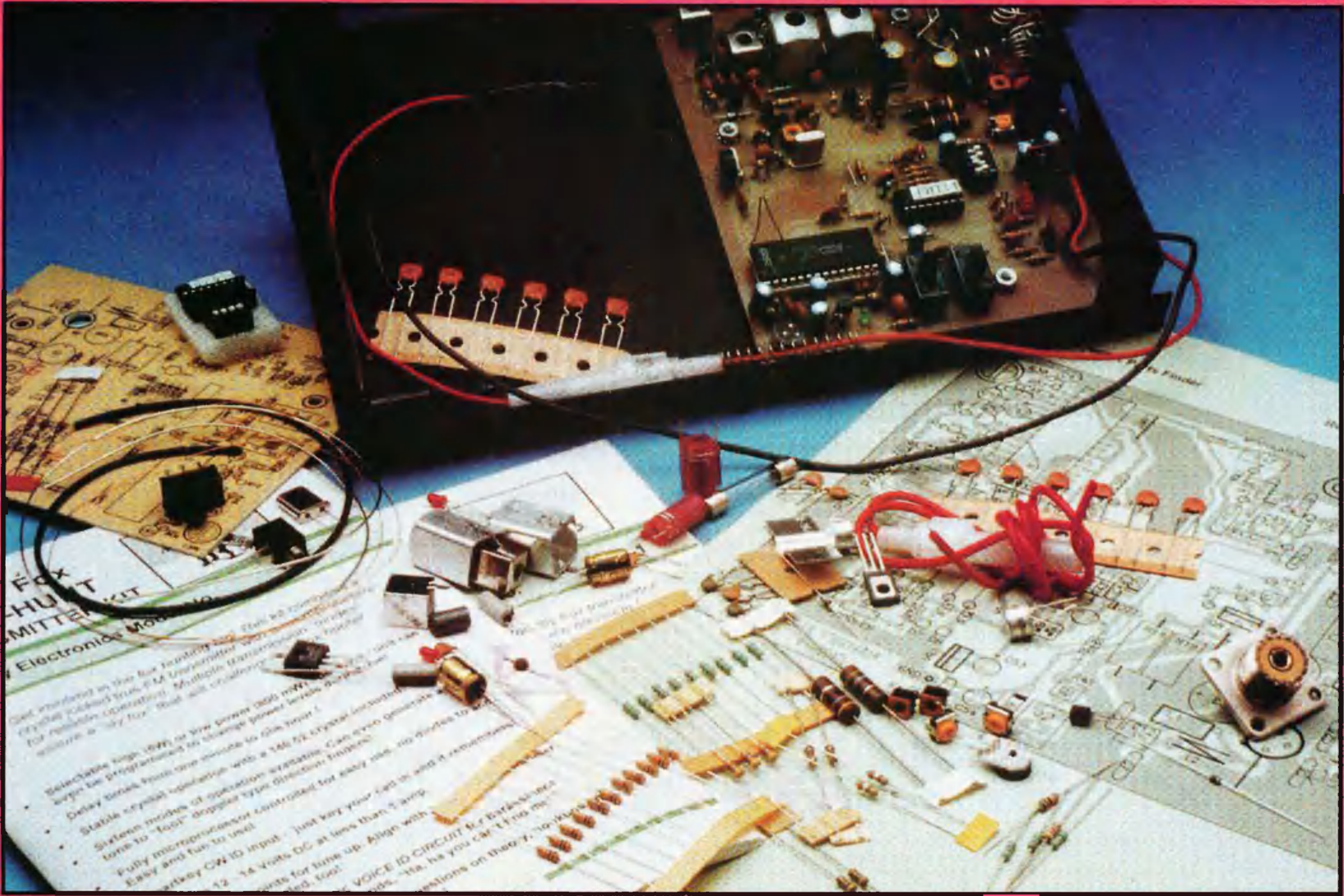
Including Ham Radio Fun!

73® Amateur Radio Today

MAY 1997
ISSUE #440
USA $3.95
CANADA $4.95

International Edition

Special Construction Issue!



Bioelectrifier Update

Hot 40-160m Antenna

TV Tuner Bonanza-II

Reviews: Timewave DSP-599ZX
WB9KZY Island Keyer
Yaesu FT-1000MP Xcvr

THE TEAM

El Supremo & Founder
Wayne Green W2NSD/1

Associate Publisher
F. I. Marion

Associate Technical Editor
Larry Antonuk WB9RRT

Nitty Gritty Stuff
J. Clayton Burnett
Priscilla Gauvin
Joyce Sawtelle
David Underwood

Contributing Culprits
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Jack Heller KB7NO
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Dave Miller NZ9E
Joe Moell KØOV
Steve Nowak KE8YN/5
Carole Perry WB2MGP

Advertising Sales
Frances Hyvarinen
Roger Smith
603-924-0058
800-274-7373
Fax: 603-924-8613

Circulation
Linda Coughlan

Data Entry & Other Stuff
Christine Aubert
Norman Marion

Business Office
Editorial - Advertising - Circulation
Feedback - Product Reviews
73 Amateur Radio Today Magazine
70 Route 202N
Peterborough NH 03458-1107
603-924-0058
Fax: 603-924-8613

Reprints: $3 per article
Back issues: $5 each

Printed in the USA by
Quad Graphics

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM (ok) or Mac (preferred) formats), carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

73 Amateur Radio Today

Including Ham Radio Fun!

MAY 1997
ISSUE #440

TABLE OF CONTENTS

FEATURES

REVIEWS

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: Ramsey Electronics' Sly Fox Fox-Hunt Transmitter Kit signals this month's construction theme. Photo courtesy of Ramsey. **The rest of you** can now get busy earning your 15 minutes of fame (and slightly less fortune) by shooting and sending in your color shots of the antenna farm, the shack, Field Day, or ??? Remember to format your goodies for cover use (and leave some mainly solid-color background for blurbs), but otherwise, the sky's the limit!

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

Never say die

Wayne Green W2NSD/1

220 Pffft?

I am pleased to report that every club newsletter I've seen that mentioned the potential loss of 144 and 450 MHz to the Low Earth Orbit (LEO) companies has 100% supported the ARRL position. I like to see solidarity like that, no matter how wrong-headed. Obviously none of the newsletter editors has read my editorial views on this subject, nor have any of their club members tuned them in. Figures.

For any newcomers, and for readers with particularly short memories, I reported that when the LEOs decided to go for our 144 and 450 bands for their satellite use, the ARRL met with them and, instead of trying to reason or come to some compromise, the League representatives threatened to have their members make life miserable for the LEOs if they didn't stop trying to take our bands.

The LEO reaction was predictable. It was the same as I would have reacted. The LEO group got mad and any chance of their backing down was blown. So I was sort of amused to read that the LEOs have added our 220 MHz band to their list. Maybe, if our paper dragon blusters some more, they'll add our 1296 MHz band to their list. Hey, it's worth a try.

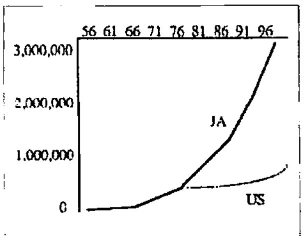


Fig. 1. Comparison of growth of amateur licenses in Japan and the U.S.

Let's look at the game board. It's a map of Washington and the goal is influencing Congress. On one side we see an army of well-heeled lobbyists surrounding the appropriate committee members, waving wads of "reelection" cash at them—on the other, an old ARRL lobbyist ham sitting there with no budget, wondering what in hell he can do.

Of course, if we had three million hams, as they do in Japan (with half our population), that would be another story.

How serious are the LEO guys? Their plan is to provide a service which will virtually eliminate the need for wires or coax into businesses and the home. Over three quarters of all the satellites planned to be orbited in the next few years are for this service. We're talking pocket telephones which will let us talk to anyone on earth. We're talking high-speed digital data and video. And all this means bandwidth (spectrum), which has to come from somewhere, and guess which "service" has the least political clout to protect its spectrum?

Who needs emergency ham communications when there are hundreds of low earth orbit satellites to relay voice, data and video to anywhere on earth? Tornadoes, earthquakes and other disasters aren't going to affect this system. So what other ham services does that leave, for us to cite as a reason for our being allocated badly-needed spectrum? We're up in the trillion dollar range.

Sure, in WWII days the ham population helped save the country's bacon by providing 40,000 radio and electronics technicians and radio operators. And before the ARRL gutted our growth with their monumentally stupid push to expand membership 30 years ago we hams were busy experimenting and pioneering new modes of communications. We were providing a very valuable service in exchange for our ham bands. Worse, if our growth hadn't been suddenly stopped, we *would* have around five or six million hams today, and most of 'em would be youngsters bent on high-tech careers, just as it was before the 1965 catastrophe.

It's going to take millions of technicians, engineers, and scientists to design, build, sell, install, operate, and service the coming world communications network. And most of these chaps are *not* going to be Americans. Not with our school system.

So can you see why the LEO group, with billions of dollars at stake, is snickering over the ARRL power play? Or why I call the League a paper dragon?

Instead of urging the hundreds of ARRL member clubs to write nasty letters to the LEO group, we might stand a better chance of survival if the clubs (a) started electing members to their state House and Senate so we'd start having some political clout, and (b) push their local school boards to institute an eight-year course in the fundamentals of electricity, computers, and communications for any student interested in being able to cope with the needs of the 21st century work force. Instead they're trying to fight an unwinnable battle which could hasten our destruction.

But I'll bet I won't see any hint of this scenario in any ham club newsletters.

On the bright side, I don't see any commercial needs for our HF bands, so I'm waiting anxiously for the sun spots to return and propagation to pick up. Amateur radio has provided me with a lifetime of enjoyment, learning and adventure. If we blow this one, I'm going to miss it.

Who are these LEO companies that the League has threatened? Well, there's Teledesic, which is planning to loft 840 satellites. That's Bill Gates and Craig McCaw. There's Iridium with 66 satellites and backed by Motorola, Raytheon, Lockheed Martin, Sprint, and 13 others. Globalstar plans 48 satellites, backed by Loral Space and Communications and Qualcomm Inc. Orbcomm plans 28 satellites, backed by Orbital Sciences and Teleglobe. That adds up to around 1,000 more satellites.

The biggest, Teledesic, will be an "Internet in the sky" and aims to replace the need for fiberoptic cable systems. These new services will allow hand-held phones, pagers, remote phones, the keeping track of trucks and planes, the remote monitoring of anything, FAX, etc. And that's what the 21st century is going to be like. We'll get used to it.

East vs. West

Take a look at the graph. It compares the growth of amateur licenses in Japan and the U.S. in recent years. The American no-code ticket resulted in an uptick of U.S. licenses. But look at what's been going on in Japan. While we have around 700,000 licensed hams on the books, Japan has now over three million! And that's with *half* our population.

One sees the difference just by looking at the Japanese ham magazine. It's well over 400 pages a month and packed with interesting-looking construction projects and technical articles. A couple of generations ago we had a section of Manhattan with a half dozen or so ham stores all in the Cortlandt Street area. Boy, did I haunt those stores. In Tokyo I just couldn't get over the Akihabara section of town where there are hundreds of stores selling electronic parts, all swarming with Japanese youngsters buying 'em by the bags full. We don't have anything like Cortlandt Street anywhere in our country anymore—with Cy W2BNW selling surplus gear, Blan The Radio Man, Harrison Radio, and so on. Sigh.

With ham clubs in every school in Japan it's no wonder they have so many hams. And, as used to happen here, a high

Continued on page 7

Number 6 on your Feedback card

LETTERS

From the Ham Shack

Ken Dumminger N8VWZ, Fremont OH. (See April's "Never Say Die.") Recently, Kenwood announced that they were changing their dealer structure to sell through more outlets. The amateur radio community was in an uproar regarding this policy. I read messages on packet that indicated that Kenwood would be selling radios at truck stops, etc. The economics is quite simple. If you are a manufacturer and your products aren't selling then you have to find new arenas in which to sell before you go out of business. When you connect to these manufacturers' Web pages you find that many of them have diversified and are selling to other markets (e.g., marine, etc.).

What I am trying to say is that in the foreseeable future we in the ham community are going to be told that our spectrum is worth a lot of money to the general public so the FCC and Congress are going to sell it to the highest bidder. Based on recent sales of spectrum by the FCC, the commercial radio community is willing to pay large sums of money to get this spectrum. An example of this is what has happened to the broadcast industry. They negotiated with Congress to lock in their spectrum for the purpose of the new digital HD TV broadcast. Recently it was announced that NBC was purchasing new transmitters for their future and the other networks are doing the same.

This leaves two other organizations that have a large amount of spectrum: the military and the amateur community. I am sure that the military isn't going to give up any spectrum, or if they do it will be minimal. This leaves only the amateur spectrum. In the past we haven't paid a cent for our spectrum, but Congress and the FCC have a wealth of buyers at their doorstep with new technologies. Where do you think they are going to look for new spectrum? It doesn't take much to figure this one out.

We as a lobby group are losing our position. The drop in membership of this fraternity is becoming alarming. We are not licensing new hams in other than Technician Class. We are hung up on the "code issue" to the point that we are willing to lose everything rather than adjust to the new markets. I am 50 years old. I have been working with my local club to get membership. Bottom line is why do I want to become a ham and pay big bucks for equipment when I can communicate either with cell phones, the Internet, or inexpensive GRS radios from Radio Shack. Young people see no need for the hobby. Older people are driving up and down the highway using cell phones and can get on the Internet for the price of a meal and can connect to anyone or anything. Even the public service people are getting so sophisticated that their need for the ham community for emergencies and public safety is becoming minimal. I recently heard a Red Cross official state that in their emergency plan they have decided to use cell phones rather than hams. While we can debate this issue for quite a long time, the simple fact is the public is going around us.

We are spending so much energy regarding classes of license and the importance of code that we have convinced the public that it is so difficult to participate in amateur radio that most don't want to get involved. Elmering is almost a lost art. Most of the interested people cannot even find an Elmer. They just go buy a book and take the test. Code, for the most part, is only used to keep people out of the hobby rather than bring them in. Older hams are reluctant to give on this issue because they have the bands and enjoy operating with less interference. The use of Morse Code for all practical purposes is gone. Most ships don't even have radio rooms. The military dropped the code years ago. I could go on and on, but the bottom line is the fact that very little licensing is being done on the level that we need to justify the spectrum. "If you snooze you lose," seems to be the position at the FCC.

The FCC is even looking at their staff. You are seeing announcements of people who are leaving the FCC to take jobs in the private sector. We are seeing the requirement for paperwork dropping. No renewal notices, instant licensing, etc. Even the testing has gone VE. What is going on? Simply, the FCC is an organization that is going to collect fees and sell spectrum. The new people at the FCC are interested in the bottom line. The technical aspect is going or already gone.

In closing, I would like to say that I enjoy amateur radio. I enjoy the activities and the technology. However, am I going to spend months learning code so that I can get permission to use the low bands? Why should I? Amateur radio is a hobby and I don't have the time to spend. I have a business and a family, plus I am involved in my community. Most of this is more important than getting a higher class license. I have no problem taking a test as to what I know... I have typing skills and a computer which is very fast. Why can't I use that and take a typing test rather than learn to reinvent the wheel? Why aren't the astronauts required to learn code to be able to fly our space ships?!

Troublemaker... Wayne.

Mike Miller WA8YKN, Richmond IN. I read the interesting report from George Bergstrom of Rancho Cordova, California, in the Letters column of the March issue, which included George's circuit for his "blood purifier." While this perhaps overly-complex circuit will probably work fine and give the same results as the other methods used to produce the same output, I feel I should point out that it violates the first rule of bioelectric experimentation. It is important that *any* device which is attached to the body via low-resistance electrodes be *battery powered!* There should be no potential anywhere in the circuit higher than that which is needed to achieve the required current flow. The Bergstrom circuit is operated from the 120-volt AC power line. There is always the possibility that someone may improperly wire the circuit, which could lead to a tragedy. Even if everything is properly connected, you should keep in mind that your *life* depends on the integrity of the transformer wire insulation every time you connect it to your body! Electrocuting experimental subjects can generate bad press. There are politicians who are waiting to do the bidding of the drug lobbyists, so let's not give them a reason we can easily avoid.

Mike's right. Batteries are cheap and lawsuits aren't. How many of you would bet your life on how well your AC line is grounded?... Wayne.

Scott Rorex KI5FC, Imboden AR. In your March editorial you asked that we let you know if we are interested in doing anything about the young ham situation. I am interested. This is what has happened here so far. Our children are seven and nine years old. I agree with your thinking about education and have tried for a couple of years to get ham radio and other technology incorporated into the existing school here.

Generally I have found the administration and some teachers interested, but the bureaucracy pretty much has tied their hands. Next, I got some extra copies of *Declare War, Dumbing Us Down, Smart Schools - Smart Kids*, and *If You Want To Be Rich and Happy, Don't Go To School*. I've handed these out to the superintendent and some teachers, principals, board members and other parents.

Your mentioning the Sudbury Valley School is just what I was looking for. When I read that I went to see if they had a Web page. They have a great one, with a list of about 20 similar schools around the world and links to several of the other schools (www.sudval.org). Please check it out. I believe that simply by making parents and students aware of the Web pages and then seeing what is on those Web pages, the bureaucracy won't be able to stop them. I see amateur radio as a perfect fit in a school like Sudbury Valley.

Thanks for helping wake us up.

Good show, but Scott, we need irritants like you in every town... Wayne.

Lester Warriner WA7HAM, Prosser WA. Please check out the ad on page 148 (March *QST*) for the ARRL Amateur Radio License Weekend Technician Class. $159 for 20 hours of class, two books and a binder. That leaves a lot for the instructor's pocket. Who said this hobby was non-commercial? And non-profit? Is Elmer really dead? Lay some green on my hand and I'll help you into this great hobby of ours! But don't expect me to do it for free. I would have thought an ARRL-sponsored class would be free except for texts. That's how classes are conducted out here. In the ARRL's official meeting they were crying about the technical incompetence of the present day ham. What technical information can be given in 20 hours? Who's kidding whom? The sickness is spreading.

That's a bunch of carp... Wayne.

Jim Ginnta WB3HDA, West Chester PA. I ordered a Bioelectrifier kit and put it together. I assumed it was just another gadget, so I let it sit on my workbench without trying it. I was sure I'd wasted my money. Then a few days ago, I woke up with a toothache. I decided to try the Bioelectrifier and see what effect it might have. I used it for 20 minutes and the toothache was gone! I don't believe this was a coincidence. I've had toothaches before and I've never known one to simply go away in 20 minutes. The Bioelectrifier works!

NEVER SAY DIE

Continued from page 4

percentage of their kids go on into high-tech careers as technicians, engineers and scientists. When I visit the research and development labs in Japan I'm greeted by hams at every turn. So we're surrounded by Icom, Yaesu, Kenwood, Sony, Hitachi, Toshiba, Aiwa, Pioneer, Sansui, Alinco, Azden, JRC, Standard, Onkyo, etc.

Of the 700,000 American hams listed in the *Callbook*, I'll bet we don't have 100,000 still active on our HF bands. The FCC keeps us on the books for ten years, even if we've dropped dead or dropped out, so that official number is seriously inflated.

Will you complain that I'm ARRL-bashing if I suggest that perhaps our faith in the League's leadership may be misplaced? Any corporation that produced such a disgraceful performance—such a loss of customer base compared to the competition—would have their board of directors and officers replaced by better performers. The ARRL directors aren't asleep, they're dead! And not only is the hobby hurting as a result, but so is our country. If this is ARRL-bashing, who else is there to bash? It's our only national organization, so we're totally dependent on the quality of its performance for the life of our hobby—and if you feel it's unfair to hold the board of directors responsible for the corporation's performance, then who do you feel is responsible? You have the proof and it is undeniable. The Japanese are kicking the s...tuffing out of us.

With over three million hams, do you think the Japanese counterpart of our FCC is going to auction off their well-occupied UHF and microwave ham bands? Not a chance.

So what can you do? I explained that a long time ago and it went in one eyeball and out the other. Get some young ham with guts in your club to run for director: get behind him with a vengeance, and help flush the old-timers out of Newington. Let's get some life into our hobby. Let's see some double-digit growth again.

Yes, I've heard all the feeble excuses. Whine, whine, the kids today, etc. Well, the Japanese kids today are going for ham radio in one hellaceous way, and they have the same toys we do. In fact, that's where most of our toys are designed and built.

I suppose I should be nice and play it cool so I don't screw up

Continued on page 39

QRX . . .

Help Wanted: Dayton Youth Forum

New York City—Educator Carole Perry WB2MGP will be moderating the popular Dayton Youth Forum on May 17th. She is looking for articulate, enthusiastic young people (8-18 years of age) who would like to be presenters. Please call Carole at (718) 761-5733 as soon as possible.

Congress Orders Reallocation of 13-cm Amateur Radio Spectrum

The 104th Congress adjourned October 3, 1996, the day after the Senate concluded its business. Much of the important legislation in the final hours was wrapped into the 2,000-page omnibus budget resolution, HR 4278.

Unfortunately, the following language was included in this bill—now Public Law 104-208. This bill was signed into law by President Clinton on October 4, 1996. Here is the text of the legislation:

Title III—Spectrum Provisions

Sec 3001. Competitive Bidding for Spectrum

(a) Commission Obligation to Make Additional Spectrum Available—

The Federal Communications Commission shall—

(1) reallocate the use of frequencies at 2305–2320 megahertz and 2345–2360 megahertz to wireless services that are consistent with International agreement concerning spectrum allocations; and

(2) assign the use of such frequencies by competitive bidding pursuant to section 309(j) of the *Communications Act of 1934* (47 USC 309(j)).

(b) Additional Requirements—

In making the bands of frequencies described in subsection (a) available for competitive bidding, the Commission shall—

(1) seek to promote the most efficient use of the spectrum; and

(2) take into account the needs of public safety radio serviced.

(c) Expedited Procedures—

The commission shall commence the competitive bidding for the assignment of the frequencies described in subsection (a) (l) no later than April 15, 1997. The rule governing such frequencies shall be effective immediately upon publication in the *Federal Register...*

(d) Deadline for Collection—

The Commission shall conduct the competitive bidding under subsection (a)(2) in a manner that ensures that all proceeds of the bidding are deposited in accordance with section 309(j)(8) of the *Communications Act of 1934* not later than September 30. 1997.

What does this language mean? On the surface it appears to mean that Congress and President Clinton have authorized the 2305 to 2310 MHz segment of our Amateur Band to be transferred into the pool for auction and competitive bidding to commercial interests, and that it will be removed from the Amateur Radio Service. That still leaves the 2300–2305 MHz segment for Amateur operations... at least for the moment. At this time no one knows exactly when the 2305 to 2320 MHz band will be auctioned and if the 2305 to 2310 MHz segment will be removed from Amateur use. The new law requires the competitive bidding to begin within six months.

According to Brad Wyatt K6WR, ARRL Pacific Division Director, the League had worked with the key Congressional members to avoid this outcome—and hoped that they would be successful. During the final two weeks of the 104th Congressional session, "...the ARRL repeatedly submitted written and verbal statements to the key Congressmen asking that Congress stay out of the direct spectrum allocation business as it has in the past." But, it was to no avail.

Congress has now directed that the 13-cm spectrum should be quickly reassigned as part of the budget and deficit reduction process. In short, the radio spectrum represents "big dollars" to the US treasury. Commercial interests have already paid more than $20 billion to the government in recently held spectrum auctions. And you can certainly expect this trend to continue. "Sell everything in sight," continues to be the policy...

TNX to *The Repeater*, November 1996, which copied it from the *W5YI Report* dated Nov. 1, 1996.

Worked All Parish Award

Since Louisiana is the only state in the US that uses parishes as its primary political subdivision (instead of counties or boroughs) and Baton Rouge is the capital city of Louisiana, the Baton Rouge ARC has decided to sponsor a Worked All Parish Award. This award is being offered as an effort to stimulate activity on the high frequency bands, and will include an attractive certificate suitable for framing.

Copies of the Rules and Requirements are available by sending an SASE to the BRARC Awards Committee at P.O. Box 4004, Baton Rouge LA 70821.

TNX L. Wayne Gordon K5EOA, President, BRARC.

Phase 3-D Launch Now Set for July, 1997

Silver Spring MD (AMSAT News Service)—A published report released on Tuesday, December 17th by the European Space Agency (ESA) has shed new light on the planned launch date for AMSAT's phase 3-D international satellite aboard the next flight of the Ariane 5 booster, Ariane 502.

Following a plan of action set in motion last September among ESA, the French Space Agency (CNES) and the firms concerned in building the rocket, a detailed timetable for operations leading up to Ariane flight 502 has now been established by these organizations.

ESA reports that, while each individual operation will require very close analysis, the Ariane 502 launch is now scheduled for early July. The last qualification launch of the Ariane 5, Ariane 503, managed by ArianeSpace, has now been scheduled for November 1997.

AMSAT-NA President Bill Tynan W3XO welcomed the news, saying that, "It gives us a definite goal to shoot for in our preparations of the Phase 3-D spacecraft; however, every month the launch is pushed back means more funds are needed." Bill noted that a letter is currently going out to all AMSAT-NA members asking for additional contributions to the project. He emphasized that, "It is particularly important to the successful completion and launch of Phase 3-D that recipients of this letter respond as generously as they can."

AMSAT is a not-for-profit, 501(C)(3) educational and scientific organization that was first chartered in Washington DC, USA. Its objectives include promoting space research and communications by building, launching and controlling Amateur Radio spacecraft. Since its founding, over 25 years ago, many other like-minded organizations have been formed around the world to pursue the same goals and who now also bear the AMSAT name. Often acting together, these groups have used predominantly volunteer labor and donated resources to design, construct and, with the added assistance of government and commercial space agencies, successfully launch over two dozen Amateur Radio communications satellites into Earth orbit.

The Phase 3-D satellite, now under construction with the help of over a dozen AMSAT groups on five continents, will be the largest, most complex, and most expensive Amateur Radio satellite ever built.

In North America, for more information contact:

AMSAT-North America
Keith Baker KB1SF, Executive Vice President
1324 Fairgrounds Road
Xenia OH 45385-9514 USA
Phone/Fax: 513-429-5325
[kb1sf@amsat.org]

In Europe:

AMSAT-Germany
Werner Haas DJ5KQ, Vice President
Holderstrauch 10
D-35041 Marburg, Germany
Phone: (06421) 684121
Fax: (06421) 285665
[dj5kq@amsat.org]
TNX AMSAT.

Hams Want Morse Code

The numbers are in, and by a wide margin hams say that they want the Morse code to stay. In a recent survey conducted by the American Radio Relay League, amateurs have made their feelings known. Sixty-two percent of ARRL members polled

said yes to keeping the code, while thirty percent said no. Of all amateurs polled, members and nonmembers alike, fifty-four percent said yes to keeping the code, while thirty-seven percent said no. In this era of the popular No-Code Tech license, amateurs say no to the total no-code licensing.

The bottom line: In months past, some high-ranking officials have publicly hinted that the ARRL might not be opposed to expansion of privileges for no-code hams. As a result of this survey, when the League goes to WRC '99, it will have to stand its ground. It will be forced to say no to those administrations whose telecommunications leaders say that it's time to delete the Morse code as a testing requirement for getting ham radio voice operating privileges on bands below 30 MHz.

Found in *SARA News*, January 1997, with TNX to *Newsline Radio*, CBBS Edition #1008, 12/6/96.

FCC Exams 2001?

Considering the general direction in which Amateur Radio seems to be heading and the climate that exists at the ARRL and FCC, I propose the following to be used as the official examination form by the year 2001...

FCC Examination Form For All Classes of Amateur Radio Operation—Jan. 1, 2001. Pick one or more of the answers as appropriate.

1) A "ham" is:

a. A delectable dish served for Christmas or with eggs for breakfast.

b. An uplifting phrase found in operations manuals for Japanese amateur equipment, meaning, "'H'onorable 'AM'erican," usually applied to the operators of said equipment.

2) A "rig" is:

a. A device used to dig wells, usually for water, but if you are lucky, perhaps for oil.

b. A device used to send electrical signals around the world. Archaic definition: "used to communicate with CW, RTTY, AM, or SSB."

Note: Since communication has long since ceased to be an objective of amateur radio, we at the FCC will not consider either answer to be incorrect. This is a freebie, not a trick question.

3) An "antenna" is:

a. A wire strung between the rafters in your attic.

b. A "flagpole" with a strange black box attached to the base.

c. A large array of tubing, wire and insulating material held from 50 to 200 feet in the air by a device called a "tower." Due to widespread ordinances, these are extremely rare, and found only in the remote corners of the desert Southwest.

4) "TVI" is:

a. Any form of interference whatsoever that is blamed on the operation of an amateur radio station. This can occur whether the station is on the air or not.

b. An abbreviation for the Tennessee Valley Inquisition, a fierce battle for tower rights that took place in the late 1990s.

5) "Guy" is:

a. A person you meet on the street and ask about the time, as in "Hey, Guy, what time is it?"

b. A wire used to hold up a tower in winds of 25 mph or less. Its use is considered to be optional by most amateur operators.

6) "Ground" is:

a. What a tower crashes into when the winds reach 30 mph or more.

b. What keeps Japan from being Line of Sight from here in the good ole U.S. of A.!

7) "Packet" is:

a. A grand experiment in digital communications that started in the early 1980s but ground to a halt because of too much infighting among SYSOPS.

b. Something you put your letters into when you really want the message to get where it is supposed to go. Stamps are applied to the outside of this packet and in a few days it arrives at its destination. Just like magic!

8) A "computer" is:

a. A device that has lured potential amateur radio operators away from the hobby by the thousands.

b. An enormous waste of time and energy, but, like women, "Ya can't live with them, ya can't live without them!"

9) A "printer" is:

a. Someone who works for the newspaper.

b. A device attached to a computer to accurately translate the tones received from the sending station into all the typos, misspellings and grammatical errors as they were originally entered by the operator.

10) "Electronics" is:

a. A mystical art that no one understands anyway, so why try to define it?

b. All of the above.

c. None of the above.

Congratulations! If you gave any answer at all to 70% of the questions above, you are worthy of becoming an amateur radio operator. Just fill out the form on the other side of this exam and send it in to the FCC offices shown at the bottom of the form.

TNX *Q-Fiver*, January 1997, who got it from *KI4QJ BBS*, who got it from Jim Stanicek AG3Y, who hopes that none of the above will be true in 2001!

FCC Plan Would Ease International Operating

The FCC has proposed amending the Amateur Radio rules to make it easier for hams holding a European Conference of Postal and Telecommunication Administration (CEPT) radio-amateur license or an International Amateur Radio Permit (IARP) from certain countries in Europe and the Americas to operate during short visits to the US. If finally approved, hams would be able to operate for short periods in participating countries without first obtaining another license or permit from the host country.

The FCC says the arrangement is intended to make it easier for US hams to operate stations temporarily in several countries in Europe, Central and South America. Likewise, hams from those countries would be allowed to operate stations in places where the FCC regulates ham radio. "We believe that US participation in both the CEPT agreement and the CITEL/Amateur Convention would benefit US amateur operators who travel to Europe and to the Americas," the FCC said in its discussion of WT Docket 96-188.

Operating authority by CEPT or IARP holders in the US would be for "up to 180 days within the preceding five years." The two classes of CEPT licenses would correspond either to Amateur Extra or Technician class. Resident aliens or US citizens could not operate in the US under a CEPT license or IARP.

Last year, ARRL petitioned the FCC to implement the CITEL/Amateur Convention. The League also asked the Commission to acknowledge arrangements to be made between the ARRL and the Department of State to issue IARP documents to US citizens for use in other CITEL countries. The FCC has asked the State Department to apply for participation in the CEPT Agreement as a non-CEPT country and expects the agreement to be concluded this year.

E-mail comments should mention "WT Docket No. 96-188" on the subject line and should be addressed to mdepont@fcc.gov. Include your full name and Postal Service mailing address in the message text. Mail written comments to: Office of the Secretary, Federal Communications Commission, Washington DC 20554—de FCC.

From *CARS, The Clearwater Connection*, October, 1996.

There's a Moral Here...

"Well, hello, Doug, good to see you. We've been trying to reach you for several days now!"

"That's interesting, Mike. I don't understand why. I have a telephone, call waiting, call forwarding, caller ID, an answering machine, a pager, facsimile machine, E-mail, all the amateur radio bands from 160 to 2 meters, packet radio, slow scan TV, and, of course, my portable cellular phone!"

"Sorry, Doug, but I simply rang your front doorbell. It must not be working!"

TNX KB8QLT, from March 1997's *Tuned Circuit*, monthly bulletin of the L'Anse Creuse ARC.

Build an Audio Multiplexer for Your Frequency Counter

Count CTCSS tones without expensive commercial equipment.

Roland Burgan KB8XI
RR1, Box 43
Hancock MI 49930
rburgan@up.net

Tired of struggling with low-end audio frequency counter readings, but not ready to shell out money for an expensive audio prescaler? Here's a much cheaper alternative.

The problem

Obtaining an accurate reading of repeater CTCSS (Continuous Tone Coded Squelch System) or tone-burst audio tones can be very difficult. If the counter's gate time is set to read out to 0.1 Hz, then usually the acquisition time required is too long. If the gate time is shortened as much as possible, the accuracy

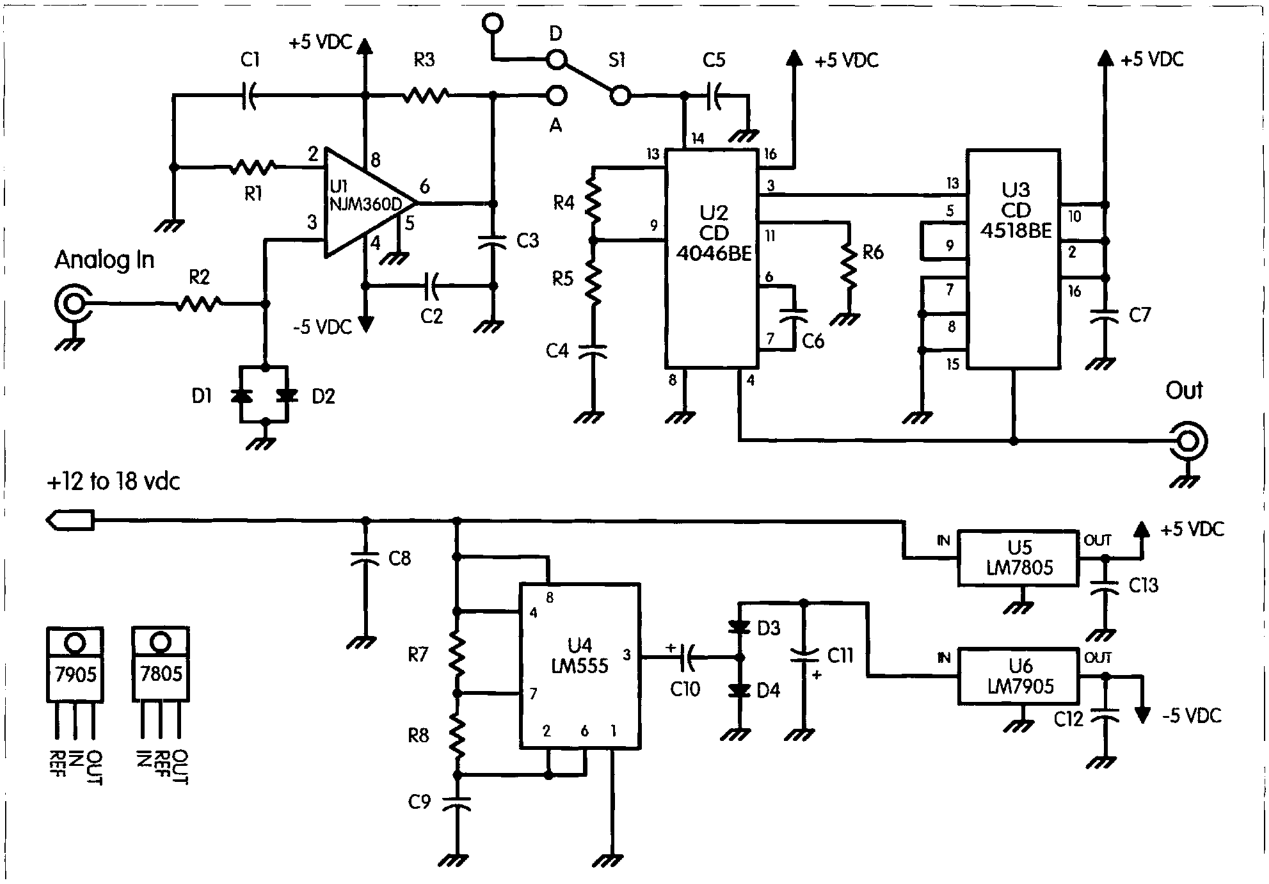


Fig. 1. Schematic for the Audio Multiplexer.

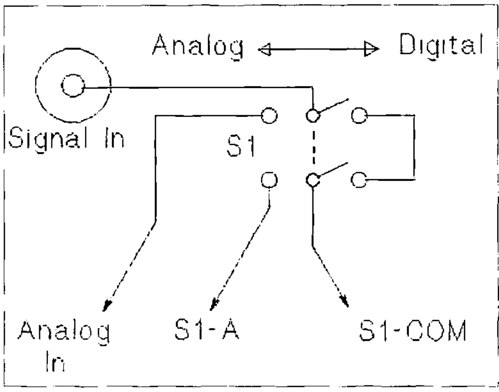


Fig. 2. For a single input, change S1 from an SPDT to a DPDT.

often proves inadequate. Until now, you had to buy either a more expensive counter or an expensive preprocessing unit to achieve the desired readout. But there *is* a way around the problem.

The solution

If we were to multiply the low frequency audio by 100, we could then get the desired digit accuracy in a fast time gate. We would only need to place the decimal point properly. Since shortening the gate time reduces the accuracy by one decade counter each step (a factor of ten), shifting the signal up times 100 restores the lost digit accuracy at the fast gate. It also adds another digit of accuracy, giving 0.1 Hz readings in the fast gate mode. The Audio Multiplexer will upconvert incoming audio frequencies through a range of 20 Hz to 8,000 Hz (8 kHz), and provide a TTL (transistor-transistor logic) output level. The unit may be powered from any single DC supply from 12 to 18 VDC.

The circuit

The circuit diagram (**Fig. 1**) shows the input analog signal fed to a voltage limiter (R2, D1, D2) to allow inputs to 50 VAC. U1, an NJM360D hi-speed comparator, amplifies and converts an incoming signal as low as 10 µV to a TTL signal. The TTL signal then goes to U2, a CD4046BE PLL (phase-locked loop). The output of U2, pin 4, is fed back to the U2 error input, pin 3, through the multiply-by-100 dual decade up-counter, U3, a CD4518BE, forcing the U2 VCO (voltage-controlled oscillator) to produce an output 100 times the original PLL input frequency (pin 14). A -5 VDC power requirement for U1 is met by U4, a 555, operating as an oscillator, whose output is rectified to produce the negative voltage. U6, a negative voltage regulator, provides -5 VDC. U5 provides a regulated +5 VDC to the rest of the circuit. Switch S1 provides for selection of analog (sine) input, or for TTL/CMOS square wave signals.

Construction

All parts are standard values, and are available from a variety of parts sources. C5 can be two .01 µF in parallel. Although the Audio Multiplexer may be wired point-to-point, the use of a printed circuit board is recommended (see Parts List). A metal box is recommended if the unit is to be used near transmitters. The choice of input/output connectors is left to the builder. Although the main schematic (**Fig. 1**) shows a split input, a single input may be used by changing S1 from an SPDT Switch to a DPDT (see **Fig. 2**). If +5 VDC and -5 VDC is already available, make appropriate connections at the connection points marked +5 VDC, and, -5 VDC. U4, U5, U6, and associated power supply components can then be eliminated.

Use

With no circuit adjustments to make, operation is simple. Just connect power, an audio source (below 8 kHz) to the input, and a frequency counter to the output. Use S1 to select sine/square input waveform. Remember to mentally adjust the decimal point two places to the left on the counter readout. Shielded cable is recommended for inputs, to minimize external noise. 73

"Remember to mentally adjust the decimal point two places..."

Parts List
(Unless specified otherwise, resistors are 1/4W and capacitors are in µF.)

R1	100
R2	2.2k
R3	3.3k
R4	1M
R5	47k
R6	4.7k
R7	1k
R8	10k
C1-C3, C7, C12, C13	0.1
C4	2.2/16V
C5	.02
C6	22 pF
C8	220/25V
C9	.047
C10	47/25V
C11	10/25V
D1, D2	1N914
D3, D4	1N4001
U1	NJM360D (hi-speed comparator)
U2	CD4046BE (phase-locked loop)
U3	CD4518BE (up-counter)
U4	555
U5	(LM)7805 (+5 regulator, 1A)
U6	(LM)7905 (-5 regulator, 1A)
S1	SPDT switch
Hardware, case, connectors	

Parts available from Mouser Electronics (East) 1-800-346-6873.
PC board available from FAR Circuits, 18N640 Field Ct., Dundee IL 60118; (847) 836-9148. $5.50 each +$1.50 S&H per order. Visa/MC accepted with $3.00 service charge per order.

Build the Bioelectrifier

Can you heal yourself and take a poke at the medical establishment at the same time?

Thomas M. Miller WA8YKN
314 South 9th Street
Richmond IN 47374

Back by popular demand, this article is reprinted—with a new addendum—from May 1996.

One of the first things a new amateur learns is that electricity and biology are not very compatible. A brush with the AC line can be a painful experience, and accidental contact with the high-voltage supply of a large transmitting tube can be fatal. Because of this early training, occasionally reinforced by an unpleasant accidental jolt, it might surprise some hams that tiny electrical currents can be beneficial to the human body.

For some time, doctors have known that passing a small current through a broken bone will cause it to heal faster. Damaged tendons and nerves also seem to respond to this treatment. Exactly why this works is not known, although a doctor once explained to me that it seemed to focus the body's attention on the area.

Recently, doctors at the Albert Einstein College of Medicine reported discovering that passing a current of only 50 microamps through the blood can prevent certain viruses, notably the HIV virus, from replicating. The current became even more effective when the polarity was reversed several times a second. The implications are enormous.

Unfortunately, there has been very little interest in this phenomenon by the medical community. Those of us who read Wayne Green's editorials have become aware of a simple device which introduces a small electrical current through the legs by placing electrodes on the ankles. Since the arteries in the legs are large, and the blood has less electrical resistance than the surrounding tissue, this technique results in most of the current flowing through the blood. This is an ideal approach for amateur experimentation, since it is totally external, and the required voltage and current levels are so tiny as to pose no danger. I decided to design such a device, using a simple printed circuit board, and easily obtained parts, so that it could be duplicated by other amateurs.

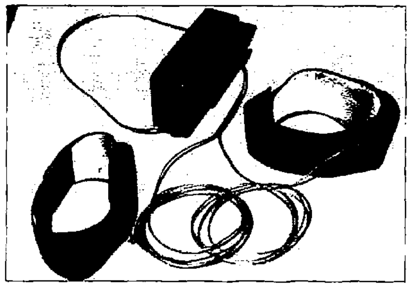


Photo A. The Bioelectrifier with belt clip and ankle electrodes.

At this point, let me state that I make no medical claims for this device. To paraphrase a famous Chief Medical Officer, I'm an engineer, not a doctor. Since very few doctors are electronics experts, there are many who would love to research the possibilities of this approach to eliminating viruses in the blood, but are unable to build the needed experimental device. They need your help.

So I present this circuit for those wishing to help doctors experiment in an unknown field, and also as an interesting study in design and construction.

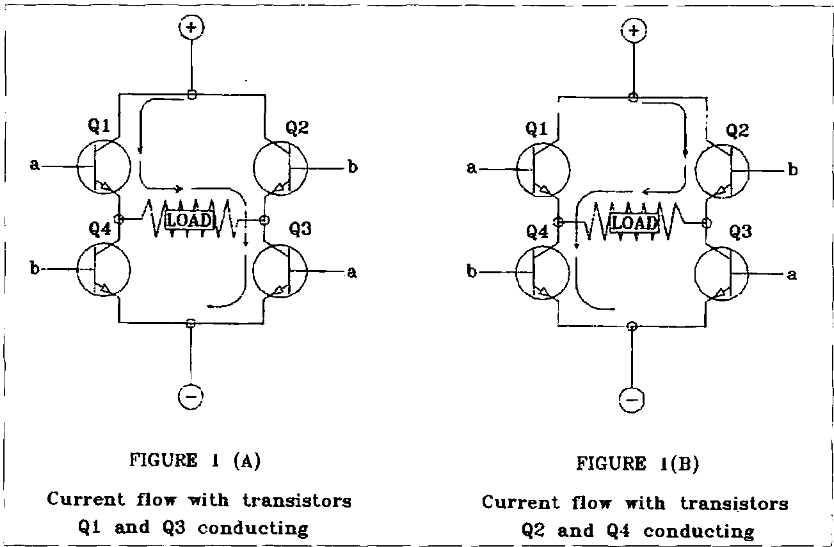


Fig. 1. Four transistors are used to reverse the current flow by being energized in pairs.

Designing a Bioelectrifier

Before attempting to design any device, it's a good idea to make a list of goals. In this case, it's a simple list:

(1) The device should produce a current flow of 50 microamps from one ankle to the other. Experimentation has shown that this requires 30 to 35 volts.

(2) It must be capable of reversing the current flow several times per second. This rate should be adjustable.

(3) It must be all solid-state—no DPDT relays clacking away, eating up the batteries.

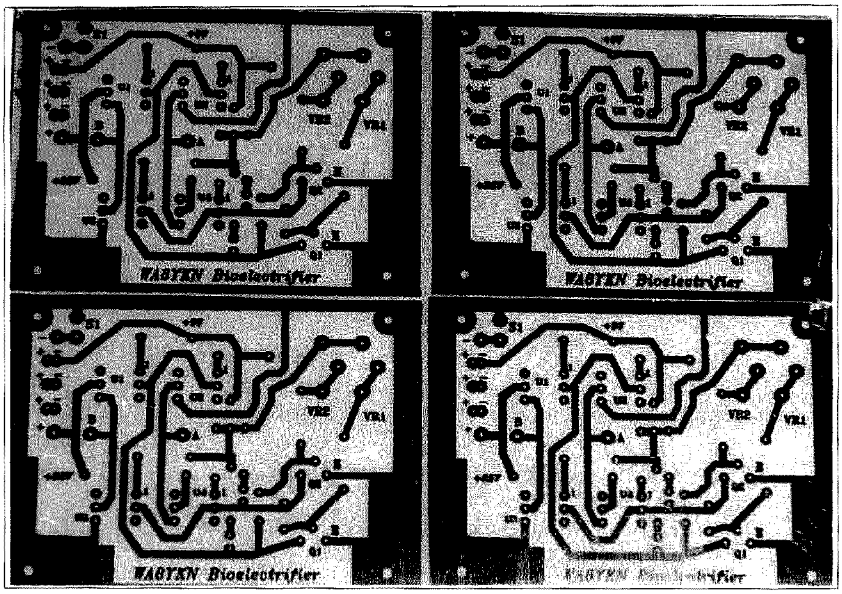


Photo B. Four circuit boards are etched on a single piece of copperclad and are cut apart after drilling.

(4) It must be small, light, and easy to carry. The ideal form would look like a pocket pager.

(5) It must have a low current drain for long life from small batteries.

(6) It must be as simple and inexpensive as possible, so that it may be easily reproduced.

This last goal is one of the most important in designing any device or circuit. It is, in fact, Occam's Razor, a corollary which states that when there are many ways to solve a problem, the best solution is the simplest one.

At first glance, it would be tempting to use logic chips, or perhaps a 555 timer and a flip-flop to get a variable timebase with an equal on-off ratio. However, this direction leads to a regulated power supply, high current drain, and a complex circuit. Also, logic chips will not switch 35 volts without an additional driver stage. Remember rule number six... the simplest way!

Maybe we'd be better off starting from the other end. Reversing polarity requires the solid-state equivalent of the DPDT relay. As it turns out, there is just such a circuit commonly used to drive and reverse DC motors. It uses four transistors in an "H" configuration, the load being in the center (see Fig. 1). When transistors 1 and 3 conduct, the current flows in one direction, while energizing transistors 2 and 4 reverses the flow. Most small switching transistors will stand up to our requirement of 35 volts at 50 microamps, but here we run into a new problem. For each direction, two transistors are in series, with the load in the middle. This creates a difficult bias arrangement to drive both transistor bases equally. Fortunately, there is a neat solution—the optocoupler. This invaluable device contains an LED and a phototransistor in one package. Energizing the LED produces light, which causes the phototransistor to conduct. No base voltage is required, therefore there are no bias requirements. Optocouplers are usually used to drive another device, but our requirements are so small that we can use them as output transistors.

The cheapest optoisolators cost less than a dollar and will withstand over 30 volts with current ratings in the hundreds of milliamps. For a few cents more, optocouplers are available that will withstand 80 volts or more.

With four optocouplers in the output of our device, all that remains is to alternately drive them in pairs. The simplest circuit to accomplish this is the multivibrator—nothing more than two general-purpose transistors, two resistors, and two capacitors. Voltage is not at all critical, and since we will be connecting batteries in series to get 35 volts, we can tap off at the 9 volt point to power the circuit. While we're at it, adding two more resistors and two tiny LEDs will give a visible indication of circuit operation and warn us when the battery goes dead.

Varying the frequency of a multivibrator requires that two resistors be varied together...no big deal. Two-gang potentiometers are ideal for this. In fact, our design goals do not specify that an equal duty cycle is required, or even desired. Two trim pots will give independent adjustment of the two states if this is needed. A fixed resistor in series with each pot will establish a maximum frequency limit, preventing the circuit from dropping out of oscillation when the pot is adjusted all the way.

We now have the basis of a simple,

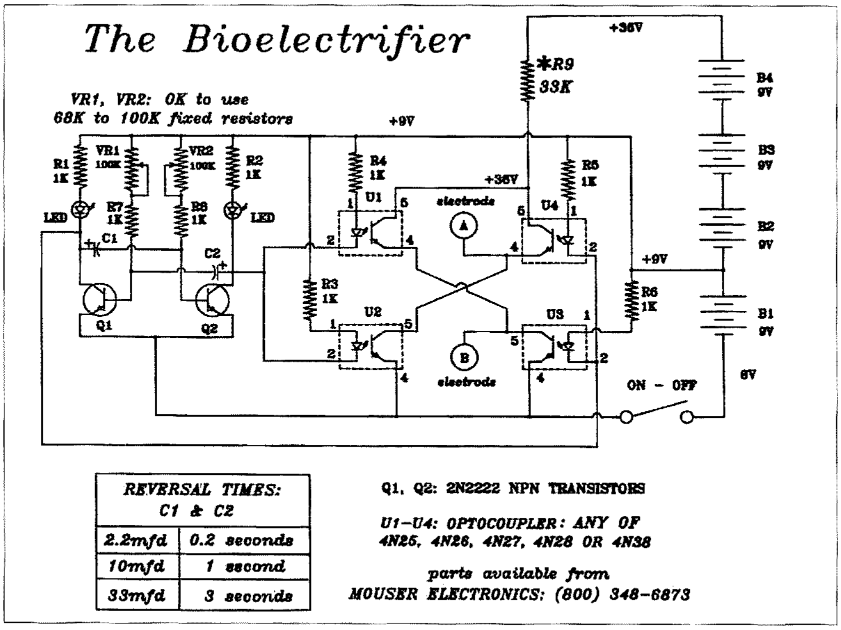


Fig. 2. Schematic diagram of the Bioelectrifier.

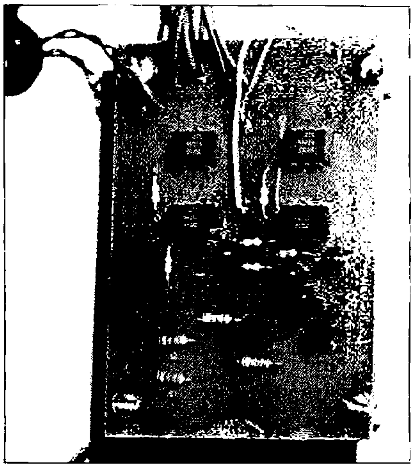


Photo C. The Bioelectrifier – component side of the board.

practical design: four optocouplers, two transistors, one dual pot, two capacitors, two LEDs, and eight resistors, all of the same value! The schematic diagram is shown in **Fig. 2.** Of course, we will have to add a box, switch, and batteries, and some sort of electrodes. We also need a name. Since we are experimenting in bioelectrics, let's call it the Bioelectrifier!

The printed circuit board

When designing a printed circuit board for this type of project, a compromise must be made between size and ease of construction. The board should be single-sided with as few jumpers as possible, and there should be enough room for 1/4 watt resistors, in case the smaller 1/8 watt are not available. The final design is shown in **Fig. 3.**

In my work, I design and build a lot of prototype circuits, and I've settled on an easy technique for circuit board fabrication. I use a Computer Aided Design (CAD) program to create the actual pattern, and then use the computer to generate a mirror image. If the board is small, as in this case, I will then copy this mirrored pattern to get the maximum number of circuits from a standard positive pre-sensitized copperclad board. This mirrored array is shown in **Fig. 4.** After printing this pattern, I copy it with a standard copy machine and inspect the copy for places where the toner is less than pure black. These areas, if any, are touched up with a felt-tip marker. When I've got a pattern that will give a good, pure black copy, I run two or three

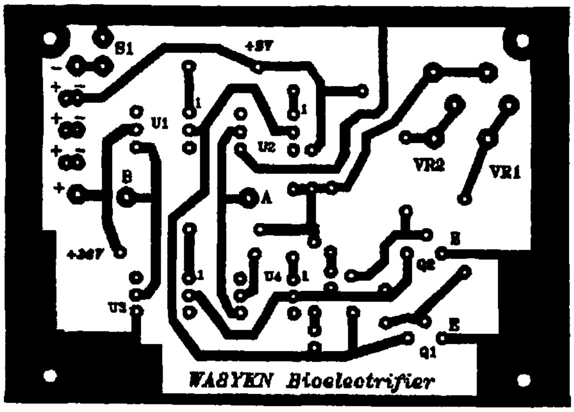


Fig. 3. The circuit board pattern, shown actual size.

copies to warm up the drum, then make a final copy on clear Mylar, sold in office supply stores for making overhead projector displays. It may be necessary to set the copy machine one step darker than normal, since machines tend to vary in how well they work with Mylar. This copy can be used as a positive for printing the circuit board.

Using a standard (4.5" by 6.5") presensitized board, place the Mylar sheet with the circuit board pattern *toner-side down* on top of the board. (The writing should be correct—not reversed!) Place a piece of glass over the Mylar to hold it in contact with the board, and expose it for three and a half to four minutes using an Ultra Violet sunlamp 12 inches above the board. Be sure to protect your eyes during the exposure!

After the board is exposed, dunk it in the developer until all the copper between the traces is shiny and clean; this usually takes around two minutes, but you really can't overdo it. Rinse the board with cold water, and it's ready to etch.

I etch my boards with ferric chloride solution in a tall, thin plastic tank that allows the board to stand up vertically. The use of an aquarium heater and air pump will cut the etching time in half. Do *not* get the etching solution on anything made of metal—it will corrode badly. It also stains everything, so wear rubber gloves and be careful!

After etching, clean the etch resist from the board, polish with steel wool, and drill the holes. The individual patterns can be cut from the board using a bandsaw, jigsaw, or even by hand with a hacksaw if that's all you have. You now have not one, but four circuit boards ready for construction.

Building the Bioelectrifier

Fig. 5 shows the parts layout for the Bioelectrifier. Be sure to install the optocouplers correctly. Also, the very small LEDs often do not have a flat spot to indicate the cathode, but instead have one lead shorter than the other. Check before cutting the leads! The *long* lead connects to the dropping resistor.

There are two ways that this circuit can be built. For experimentation, the device can be mounted in a larger box, potentiometers used to vary the frequency and current, and perhaps even a microammeter to monitor the current. However, I've discovered that it's not always wise to give a device with many controls to a non-technical person, especially if changing any of the adjustments would nullify the experiment. Also, we want a pocket-sized device, or one that can be clipped to the belt. Once the operating parameters are established, the resistance of the potentiometers can be measured and the pots replaced with fixed resistors (I used 68k). This makes a much smaller package possible, with only a single on/off switch and two tiny LEDs on the outside. I built one in a 2 7/16" by 5-1/16" plastic box (Radio Shack 270-233) and mounted the switch and LEDs in the end. Four 9 volt batteries would not fit in this box, but one 9 volt and two 12 volt "N" batteries will fit with no problem, and produce 33 volts. Radio Shack sells 12 volt alkaline "N" batteries in a package of two, (23-154) and "N" battery holders (270-405).

I made a belt clip from a strip of steel banding material and glued it to the back. I also glued a two-pole terminal strip to the end of the box to connect the electrode leads, although a plug and jack would be fine. I used what I had on hand.

Electrodes for the prototype were simply strips of aluminum foil, folded to form two strips several layers thick, 2 inches wide and 12 inches long. Wrapped around each ankle, the foil was held in place by rolling the socks up over it. Later, a better electrode was made by gluing aluminum foil to strips of cloth-backed vinyl

upholstery material, with hook-and-loop fastener material glued to the ends.

In either case, connect two 36-inch lengths of hookup wire to the Bioelectrifier's output terminals, and solder a paper clip to the other end of each wire. Slip one paper clip over each electrode, clip the Bioelectrifier to the patient's belt, and your doctor is ready to go.

OK, it's done. Now what?

Even if your doctor doesn't know anyone with the HIV virus, there are many experiments he can try with the Bioelectrifier. If it works on the HIV virus, what about others, such as those responsible for herpes, Epstein-Barr, colds, and flu? Will a few minutes a day actually *prevent* colds and flu? What effect will different frequencies have? The long-term benefits can only be determined by experimenting and recording the data.

It is interesting to note that all animal life on earth has evolved in the magnetic field of the planet. Blood, being mostly water and containing salts and iron, must generate a tiny voltage as it moves through this field. Is this voltage necessary for good health, and can it be disrupted by exposure to much more intense 60 Hz electromagnetic fields?

I've often wondered, as we think about manned missions to other planets, if we will one day discover that we cannot live for a great length of time without the Earth's magnetic field. So far, only a few people have ever left the planet, and only for a short time. These astronauts, however, have found that after a few days in space, the immune system starts to shut down! No one has yet found a good explanation for this. Perhaps a small application of bioelectrics is in order!

One interesting result reported by Wayne Green was that when his friend Beck used a similar device for two hours a day instead of the usual 20 minutes, just to see if there might be any harmful effects, he started losing weight! The weight loss continued until he reached his normal weight, then stopped. Since, as Wayne has repeatedly noted, many hams appear to be "eleven months pregnant," this could be the biggest thing since FM! Perhaps this device will open new fields of communication. Just adjust the frequency to match the 7 Hz resonant frequency of the Earth and tune your brainwaves to Dr. Jung's Universal Consciousness!

All kidding aside, there have been enough results from experiments to date to warrant serious study, and, as usual, mainstream science will continue to ignore it, while sucking up government funds for expensive and ineffective research. But breaking new ground is the amateur's forte. We have the technical skills and the manpower. Keep in mind that *every* new field is pioneered by amateurs—since the professionals do not yet exist!

One final caveat... *do not* build Bioelectrifiers and sell them as medical devices! This will surely bring unwanted attention from the wrong people. After all, these days even the U.S. Department of Health and Human Services has a S.W.A.T. team! So build it, work with a doctor to experiment, and make sure to keep careful records. Don't even give one away to someone who wants to try it but doesn't have the skills to build it, unless you have no qualms about opening yourself to almost unlimited liability. Remember, the FDA and several other government agencies have unlimited funds to persecute you, and they love nothing better than the slightest excuse to appear to be working. The last thing you need is to get the attention of the bureaucrats, who would probably protect the interests of the pharmaceutical cartels by outlawing bioelectricity, requiring us all to wear grounding straps on our behinds.

ANSWERS TO FREQUENTLY-ASKED QUESTIONS [NEW]

The response to the Bioelectrifier has been incredible. It's been a year since the original article saw print, and I can still count on a stack of letters every week. This stack becomes a flood whenever Wayne guests on the Art Bell show. Since there are common threads to many of these letters, I thought I should address some of the most frequently asked questions.

Bare circuit boards for the Bioelectrifier are available from FAR Circuits, 18N640 Field Court, Dundee IL 60118. And no, the phone has NOT been disconnected... the Chicago suburbs were assigned a new area code. Fred's number is (847) 836-9148.

Unlike the Rife devices, this circuit achieves its effect with direct current. However, the polarity must be constantly reversed because the body tends to quickly "charge up" and the current flow drops off. The frequency does not seem to make much difference, and I've used rates from 20 Hz down to 0.2 Hz successfully. One fellow sent me a very long table of resistor-capacitor values and wanted me to fill in the frequency for each combination! (Yes, he was a ham.) The time constant will vary slightly with the leakage of the transistors, but you can get very close by multiplying MEGOHMS by MICROFARADS to get time in SECONDS.

The original ankle cuffs lined with foil made a good "field expedient" electrode, but after a time, the foil becomes wrinkled, and the resulting hot-spots feel like tiny critters nibbling at your ankles. An alternative is to line the cuffs with 2-inch-wide heavy stainless-steel tape, available from any auto parts store, or by mail from J.C. Whitney. This material is heavy and polished, and doesn't wrinkle easily. It's also possible to take the advice of Dr. Hulda Clark and wrap a layer of saltwater-dampened paper towel between the metal surface and the skin. If the electrodes are working properly, you can't feel 100 microamps.

By far the best alternative is the disposable EKG electrode. These are "peel-and-stick" with a non-messy conductive jelly. These are so good that you can get two to three times the current flow and not feel a thing! They are available from your doctor or chiropractor, or you can order them through your pharmacist. EKG leads are

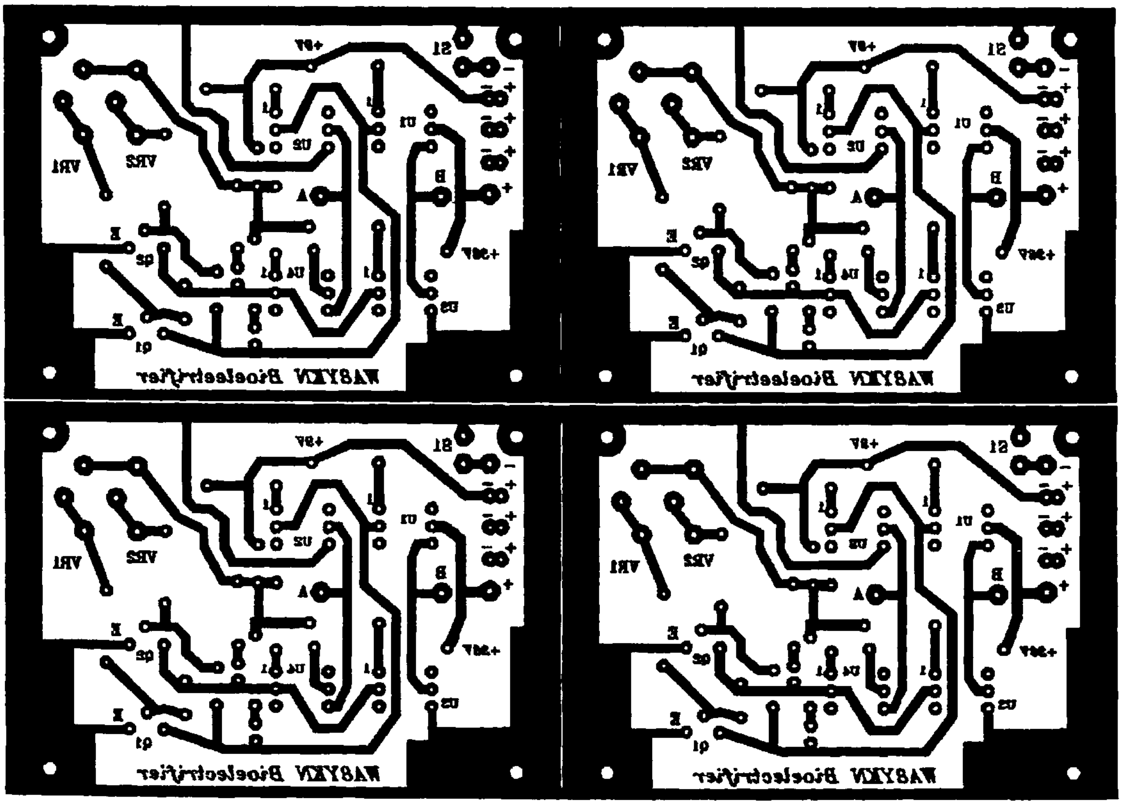


***Fig. 4.** Make your own "positive" by copying this mirrored pattern onto clear Mylar. Shown actual size.*

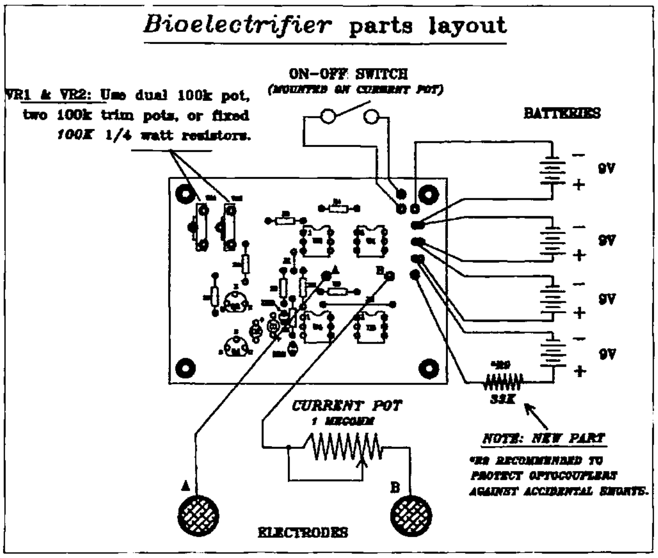


Fig. 5. Component side of the board, showing the component locations and connections.

made to snap onto the electrode, but small alligator clips work just fine.

If you write to me for information, please include a business-size SASE. My updates are now running three pages, so a post card won't do it.

While I can answer questions about the circuit, availability, and operation, remember that I'm an engineer, NOT a doctor. Please don't send me a letter detailing your health problems and asking for advice. That would put me in the position of practicing medicine without a license, and I can't do that! For information on what others have done and their results, get a copy of Wayne Green's AIDS booklet. Also, Dr. Bob Beck lectures all over the country, leaving a trail of informative audio tapes and written reports in his wake. By the way, Robert C. Beck, D.Sc. and Robert O. Becker, M.D. are NOT the same person!

An important point brought up by Dr. Beck is that when using any bioelectric device, it's necessary to stay away from toxic drugs, alcohol and even herbs. An effect called ELECTROPORATION can increase the effect of these chemicals and cause toxic effects from a normally harmless dose. Dr. Beck also stresses the importance of drinking lots of pure water before, during and after using any bioelectric device.

I hope that readers will share the results of their experiments with the Bioelectrifier. You can write to me, or send me E-Mail at [thomil@infocom.com]. My Web site [http://www.infocom.com/~thomil/] is a good place to watch for new information, which I will post as it arrives.

—Thomas M. Miller WA8YKN

Bioelectrifier Parts List		
Part(s)	Mouser #	Radio Shack #
2 Transistors	333-PN2222	276-2009
4 Optocouplers	512-4N38	—
2 LEDs	351-3001	276-026
1 Dual Pot	31VA501	271-1732
2 4.7µF Capacitors	140XRL16V4.7	272-1024
8 1k Resistors	299-1k	271-1321
1 9V Snap	12BC310	270-405
2 "N" Holders	12BH510	270-405
1 Meg Pot	—	271-211
1 33k Resistor	—	271-1328
Box, switch, batteries, etc.		

Materials for Circuit Boards

Materials for making your own printed circuit boards are available from Circuit Specialists: (800) 528-1417

Part	Number
Sensitized Boards	PP114
Developer	Posdev
Etchant	ER-3

NOTE FROM W2NSD/1

I would make a lot more noise about this except for two things. Make that three. First, I'm not an MD, so the medical industry will probably have no interest in anything I have to offer. Second, efforts to try and bring down the cost of medical treatments could easily trigger an FDA attack and prison. Third, I need more people to call or write to say they used it with success. I've never had anyone write and say they had tried it and it didn't work, but I'd like more positive testimony.

Multi-Band Remotely-Tunable Inverted L Antenna

Here's a neat 160-40m wire antenna project using flexible parts-placement techniques.

Ronald Lumachi WB2CQM
73 Bay 26th Street
Brooklyn NY 11214-3905
E-mail: WB2CQM@Juno.Com

In the vast majority of antenna building projects, it's safe to assume that no two identically constructed arrays will exhibit the same electrical and performance parameters. Ground characteristics, proximity of trees, antenna length, contiguous buildings, height above ground, coaxial cable loss, velocity factors, etc., affect the ability of the system to radiate energy with a performance level equal to the criteria listed in the reference source.

When I set out to build, install, and test a base-loaded, remotely-tunable, multi-band inverted "L" for my home QTH, and then duplicate the project for my country location, little did I realize that the two locations had absolutely nothing in common with each other except that space was restricted for antenna erection. Ah! Ignorance is bliss!

I expected to breeze through the installation. For example, in order to raise the vertical portion of the antenna, I'd use the tower in the city and a convenient tree at the country location. The tower would be easy to climb to attach the supports. In the country installation, a slingshot, fishing pole, reel, monofilament line, sinker, pulley, and some nylon rope would make short work of this obstacle.

So, in my naiveté, I started on the city prototype. Duplicate capacitors, coil, motors, and hardware were assembled to address the requirements of both base-loading networks. After constructing the first matching network; wiring the entire assembly into the ground system (including the piping of my backyard well and the tower itself); and juggling components, the unit did a more than respectable job on 80/40 meters. Tweaking performance while surfing the frequency was as simple as toggling power to the remote motors and tuning for low SWR.

Confident in my skills, off I went to the country, armed with a clone of my successful prototype. I made absolutely certain that all the components were carefully spaced, firmly installed, and well bonded. Solder connections were double-checked for integrity and the circuitry was verified.

Suffice it to say that no manner of effort could get the array to work. Rocks, instead of concrete, and trees, instead of buildings (and who knows what else), all conspired to make for a monumental non-event. When every possible variation and combination of profanity had been expended and a cooler head prevailed, it became evident that obstacles had to be overcome by altering component positions (coil-capacitor relationships) to compensate for what I now knew to be a vastly different set of antenna-matching parameters. Exasperated, I took the unit apart.

That disheartening disassembly experience, however, resulted in the development of the construction techniques in this article. In a nutshell, it's a system of breadboarding using jumper cables, rather than hard wiring. It's easy to change component configurations within a circuit, on a temporary basis, of course, to maximize antenna performance for a particular locale.

Then, and only then, can all the parts be hard-wired into place, for a solid, low-loss, high-performing matching network.

What's first?

To utilize this strategy successfully, it's vital that you overcome the mindset that the location and hookup of the coil and capacitor components in the matching network are cast in stone! Simply because they were used successfully in one set of circumstances does not guarantee automatic success in another (seemingly similar) situation. Keep in mind that although the number and value of components may be the same, the way they're wired into the system and how they respond to the peculiarities of a particular environment make a world of difference.

Fig. 1 shows that there are plenty of matching options at your disposal to achieve that elusive 1:1 SWR. With that firmly in mind, a quick hookup technique gives you great flexibility, and minimal timewasting, moving components in and out of a circuit to test the various configurations. The goal is maximum signal radiation coinciding with the lowest standing wave ratio with the least expenditure of effort—the most gain with the least pain!

The answer is not to remove, rebuild and rewire the unit after each unsuccessful attempt to power up the antenna. That strategy becomes a tedious chore, increases your level of frustration, and is no longer even *close* to a remotely

rewarding situation after even only one or two failures. To make life easy, simply bypass the continual disconnecting and moving of hard-wired components by electrically isolating each of the discrete parts used in the circuit (coil, capacitors, tie points, etc.) and prepare jumper leads to complete temporary configurations.

If a particular arrangement does not work, remove the jumpers, refer to a second schematic, and reconnect for another try. If memory serves, programming the old IBM mainframes (circa 1960) was accomplished in the same manner, using a rat's nest of jumpers and clips. There's really nothing new under the sun!

Gathering the basic parts

It's a good idea to locate a source of supply and to purchase all the parts before planning any further. Reasonably-spaced air-variable capacitors as well as coils are expensive, so check the surplus catalogs, or scout a local hamfest for these items. In my case, I found that my primary loading capacitor with about 1500 pF, borrowed from an old linear, worked well. I also used a moderately-spaced dual-gang variable (150/150 pF) for the second unit. This component can be paral-leled for increased capacitance (with jumpers, of course), or left as two independent units for wiring up **Fig. 1(i)**.

It's important that both air variables rotate a full 360 degrees, since they will be driven remotely by the gear motors. As a last resort, the capacitors may have to be purchased from retail outlets; however, home-brew coils constructed from readily available material and tailored to the project's specific needs can save a bundle.

If you decide on remote tuning, pick up one or two gear head 1-rpm reversible motors. To reduce project costs somewhat, the second motor (or both) can be a standard 1-rpm synchronous model. It works just as well, but I found that it wasn't as convenient for quick fine-tuning. Try to find units with identical driving voltage requirements. Suppliers are listed here, but they should be telephoned to verify current inventory.

Parts List and Suppliers

Part #	Description	Radio Shack #
SW1	SPST	2755651*
SW2	DPDT	275652*
SW3	SPST	2751556*
SW4	SPDT	275709*
NE1	Neon pilot, (110 VAC)	272707*
5-conductor rotator cable		151201*

* Radio Shack or equivalent

Synchronous Motor Suppliers
check with supplier for current inventory

Marlin P. Jones (800) 652-6733
Lake Park FL

Surplus Center (800) 488-3407
1015 West "O" Street
Lincoln NE 68501

Fair Radio Sales (419) 223-2196
Box 1105
E. Eureka Street
Lima OH 45802

Variable Capacitor Supplier
Kilo-Tec (805) 646-9645
Box 10
Oakview CA 93022

Don't forget to scout the local hamfests for your needs. You'll need everything at hand to lay out the parts in the most compact manner. Keep in mind that all the components are mounted above ground potential.

Since the matching unit also needed to be protected from weathering, the container selected was nonconductive PVC. I made a quick visit to the housewares department of the local K-Mart™ and ended up with a plastic box originally designed for storing shirts and sweaters. You'll discover an almost endless array of sizes, but it's important that there is adequate depth so the cover can be fitted for weatherproofing without any obstruction.

With the exception of the coil, all the parts were mounted directly to the

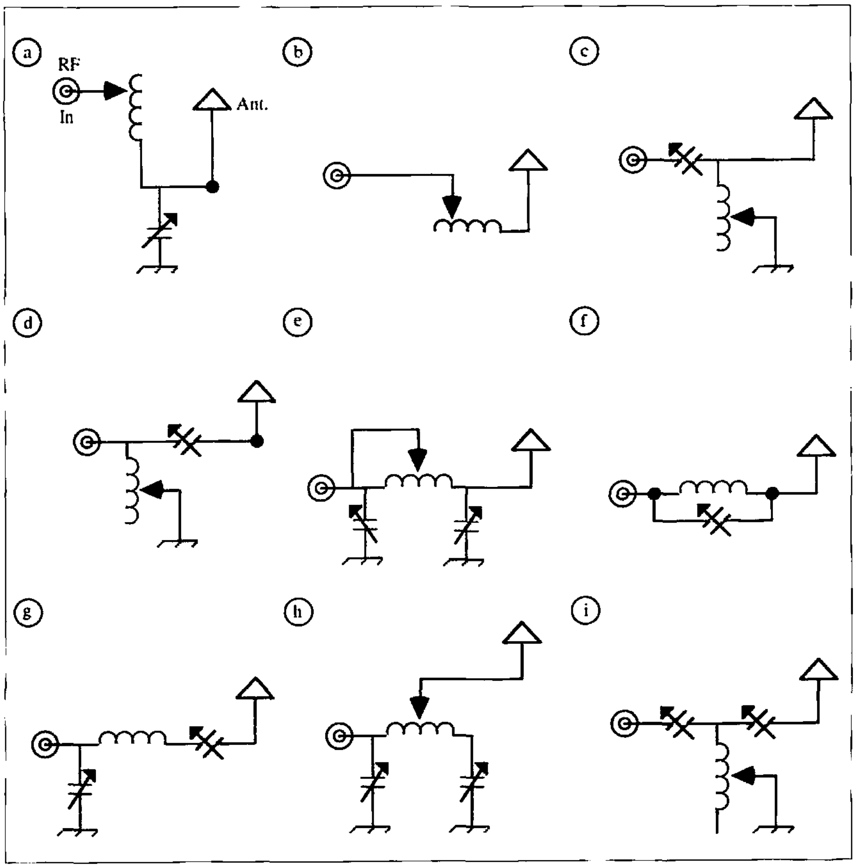


Fig. 1. Possible coil/capacitor combinations for antenna matching.

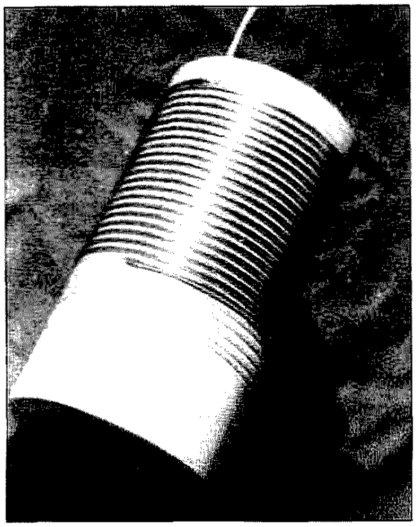


Photo A. The six-inch length of PVC piping, threaded at 6 tpi, with the coil temporarily wound on the form.

container using junk box hardware. As a precaution, the coil was further isolated from the other components by using short porcelain standoffs. All that remained was to construct (or purchase) a hefty wide-diameter coil that would provide about 22–28 mH.

Home-brewing the coil

If you want to experience sticker shock, take a look at the prices for air-wound coils with 3 to 3-1/2" specs. I decided to wind my own using a section of 3" PVC tubing (3-1/2" OD) 6" long and 22-24 turns of #10 AWG solid copper wire at 6 tpi. Look for discarded PVC cutoffs at a new home construction site (with permission, of course) or purchase a 3-foot length at a home improvement center. It's cheap enough and there will be many other occasions when there will be a need to wind coils.

You'll need approximately 25 feet of solid bare wire (available off the shelf from an electrical supply house or other source). If you experience any difficulty in locating this type of material, electrician's household AC wire with the protective covering is OK (#12 AWG wire can be substituted with only a slight reduction in performance). Suppliers will cut it to length off a roll, but make certain that it is not kinked in the process.

"Don't be afraid to tweak your signal with the rocker switch."

Removing the covering is tedious, so it's vital to have a wire stripper with a fixed calibration for 10-gauge wire. Clamp one end of the wire in a vise or loop it around a fencepost and stretch it taut. Remove repeated 6-inch lengths of plastic insulation material by walking the covering down the length of wire. Try not to nick the wire, because that creates an obstacle to the smooth removal of the covering as you move each length down the wire. It may help if you keep the bare wire lubricated with concentrated dishwashing liquid.

Although not essential for winding accurately-spaced coils, it helps if you can have the PVC tubing threaded or at least scored at 6 tpi. If you're not fortunate enough to have (or have a friend with) a lathe, visit your local machine shop. It makes for foolproof winding, but again, threading or scoring is not essential for this project.

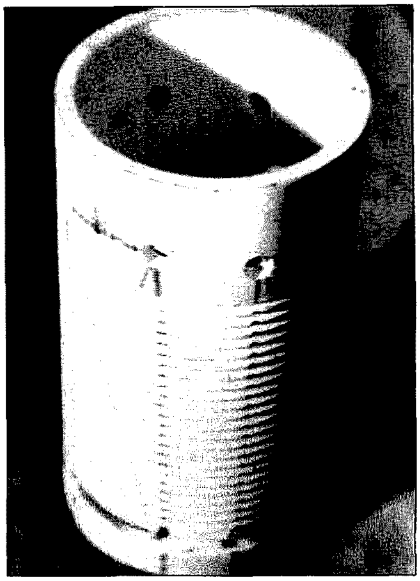


Photo B. Remove the coil and measure the 4 sections. Cut away the four 2" x 4" sections (marked with the X).

Assuming you're unable to have the threading done, close-wind the full length of wire on the form, keeping the wire taut (**Photo A**). Do exactly the same thing for the lathe-prepared coil form, except follow the threading. In either case, remove the coil of wire from the form after winding. You'll find that your newly-wound coil resembles a Slinky™, and it will be OK to reminisce about your childhood (but only briefly). Force yourself not to try it out on the staircase, since it doesn't have quite the same characteristics as the original.

Using a tape rule, measure around the perimeter of the PVC pipe and divide the circumference equally into fourths (approximately 2-3/4" intervals) (**Fig. 2**). Using a try square, draw a pencil line down the length of the PVC, perpendicular to the face of the pipe at each of the four points. Draw two parallel lines one inch on each side of the reference line, stopping one inch from each end of the PVC. Form four rectangles (each measuring 2" x 4") and drill a 3/8" starter hole at each of the eight *inside* corners (**Photo B**), and use a saber saw to make the cutouts as shown.

Before rewinding the wire onto what has now become an air-wound form,

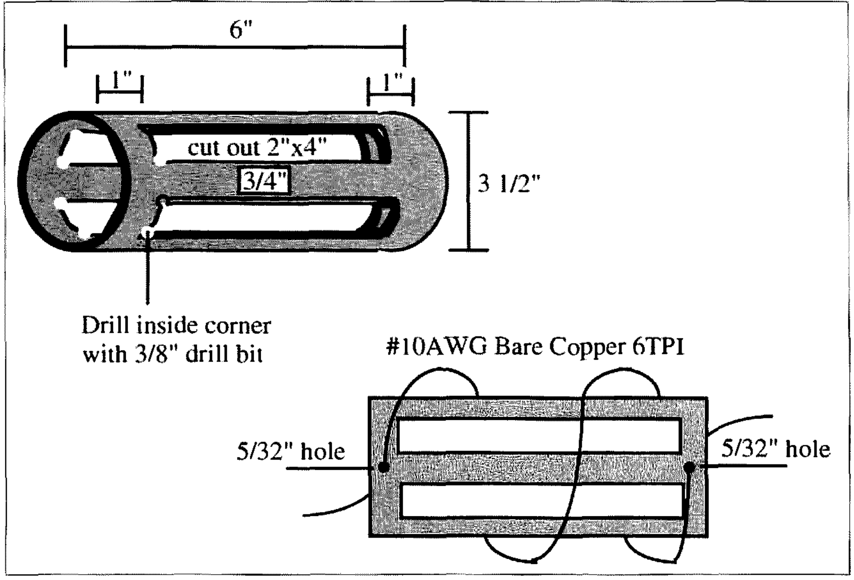


Fig 2. Coil form details.

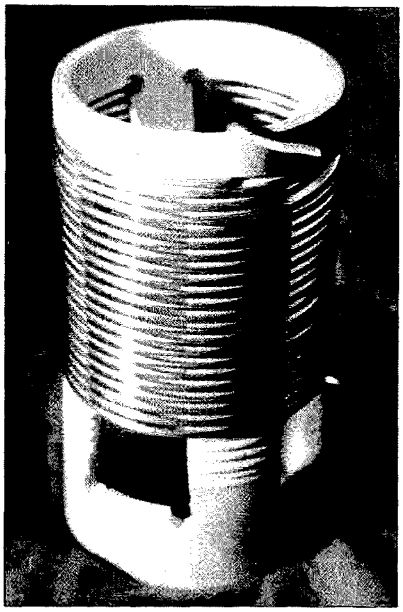


Photo C. Rewind the coil on the form. Note that the ends of the coil are protruding from the top and the side and will be used for hookup points.

drill two 5/32" holes in alignment along one of the support ramps one inch from each end of the PVC. If your measuring and cutting is reasonably accurate, the remaining four sections of wire-supporting PVC should each measure approximately 3/4" x 4" long.

Start the rewinding process by placing an end of the coil into one of the small holes (**Photo C**). Rewind your Slinky, keeping a moderate tension on the form. It might help if you can borrow another pair of hands, since 10-gauge wire often has a mind of its own. At the 24th turn, thread the end of the coil into the remaining hole, give it a twist with a pair of pliers, and you're ready to move on.

Leave a sufficiently long pigtail on each coil end for hookup points. If the form is not threaded, adjust the spacing evenly along its length. If you're concerned about minor changes in the value of inductance, run a couple of beads of silicone caulk or hot glue along the coil's length to ensure rigidity.

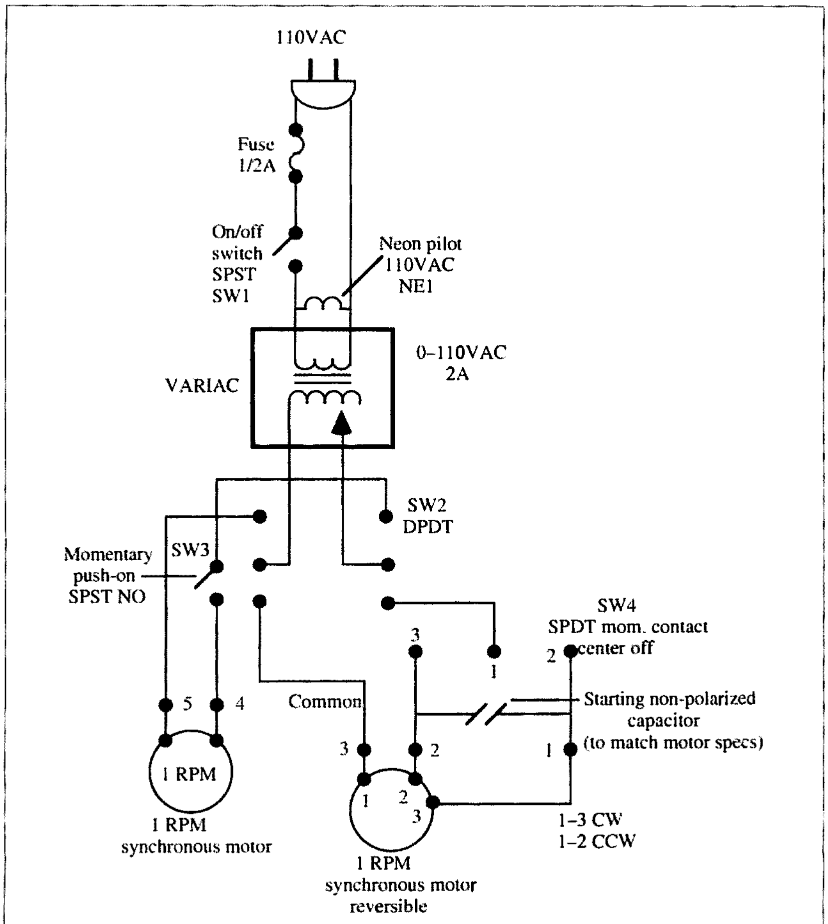


Fig. 3. Straightforward power supply wiring schematic to power the two remote synchronous motors.

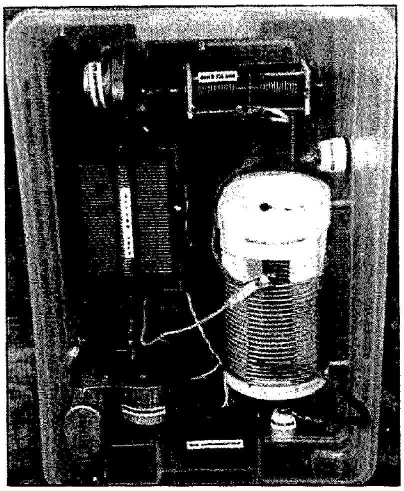


Photo D. Located below the coil is the antenna input feedthrough insulator. At the upper right is the antenna output feedthrough.

The home stretch!

Mount each of the components and drive motors directly onto the enclosure. Don't forget the standoff insulators for the coil. Use my model (**Photo D**) as a placement guide or feel free to configure your own. Mount feedthrough insulators on the side for the antenna output and one on the bottom for input. A heavy brass nut, bolt, washer, and solder lug provide for a solid ground attachment point.

I used a five-position barrier strip to wire the remote tuning motors, via a five-strand rotator cable, to the 110 VAC variac supply. The Powerstat driven voltage supply was used only as a convenience to drive gear motors of any voltage. Often, it's pot luck when you're looking for appropriately rated miniature AC motors, and only odd voltages are available. Incidentally, it's usually cheaper to buy 20 VAC units instead of 110 VAC models, for obvious reasons. Remember, if you want to stay flexible use a variac with this aspect of construction. However, discrete isolation transformers, with output ratings to accommodate odd motor voltages, can be substituted and will work just as well.

Keep in mind that the use of a variable-voltage power supply option will not affect the shaft output speed if you deviate from the synchronous motor's voltage rating. They're specifically designed that way in order to maintain rated output even with 10-20% powerline fluctuations. Check **Fig. 3** for the straightforward wiring of this power supply component.

I used a scrap piece of 4-inch PVC and two matching caps to form the enclosure (**Photo E**), but any type of case will work just fine. The 2-amp variac was mounted inside one of the PVC caps along with an on/off switch and a power indicator light. Five binding posts were placed near the bottom of the unit. In close proximity, mount a DPDT and SPST (normally open) momentary-contact switch. These toggle voltage to the two motors and activate the 1-rpm synchronous motor, respectively. The momentary-contact center-off SPDT switch drives the reversible motor and will change its rotation

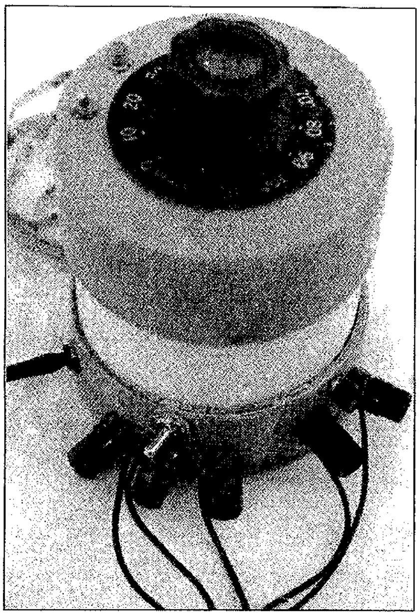


Photo E. Two PVC caps and a short length of four-inch plastic pipe provide an enclosure for the variac AC power supply.

depending on the switch position. This is a great (optional) feature since it allows you to rock the capacitor to tweak the output (**Photo F**). Use self-tapping screws to secure both the top and bottom cap to the length of piping.

Solder eight- to 10-inch tinned lengths of 58U copper braiding or flexible wire to the input and output of the coil and capacitors, and attach alligator clips at each of the ends. Prepare an additional supply of jumper cables with double-ended clips (**Photo G**). Mount the matching network enclosure near the base of the antenna. Wire the coax to the input and ground, and the output to the longest length of antenna you can muster.

Use a strain insulator between the antenna and the network's input to

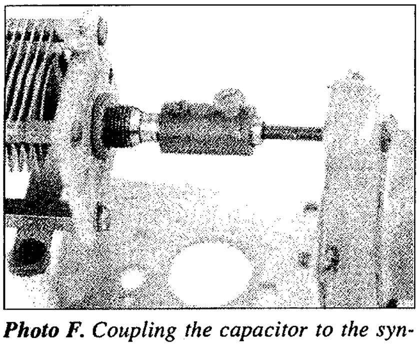


Photo F. Coupling the capacitor to the synchronous motor can pose a minor problem if the shafts have different diameters.

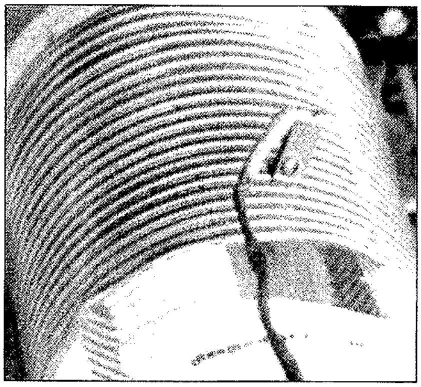


Photo G. The alligator-type jaw of a clip I found at a hamfest is opened by loosening the set screw and then pressed onto the coil.

eliminate the possibility of damage from the wind. Before flat-topping the array, it's always a good idea to get the vertical radiating portion up as high as possible for the best propagation characteristics. Although random lengths of wire will usually work okay, it is preferable to measure out multiples of 65' to ease loading.

Using the jumpers, wire up the first circuit following one of the schematics. I've found that the MFJ-249 SWR analyzer quickly indicates if you're on the right track and is infinitely more convenient than using your transmitter and SWR bridge. It's great to watch the SWR dip as the capacitor values interact in the matching network when altered remotely from the convenience of the shack.

If you're not happy with the results, move on to the second wiring option and hit your switches. Coil taps may have to be altered, but it won't be long before the exact combination of components and values will be radiating your signal into the air where it belongs. When the best combination has been determined, and maximum signal radiation has been achieved, replace the jumpers with hard wiring and install the weather-protective cover.

Once you're set up on any frequency, don't hesitate to make excursions over the entire band and tweak your signal by using the rocker switch to dip the SWR meter. If you're fortunate, you'll find that you can tune 40 meters with a minimum of capacitance and move to 75/80 meters on the same coil tap by adding more capacitance. Try it—you'll like it! 73

Ham Vacation

A six-week journey through Yugoslavia.

George Pataki WB2AQC
84-47 Kendrick Place
Jamaica NY 11432

In the summer of 1996, I visited many amateurs in Hungary and Yugoslavia. I was able to see many radio clubs and personal stations, where I noticed the large number of YLs and XYLs, as well as youngsters, participating in the hobby.

Family ties in eastern Europe may be stronger than those in the West. This can be attributed to tradition and education, and perhaps to the fact that there are fewer attractions available outside the family than there are in more affluent societies.

In Yugoslavia, a large part of ham activity is in radio clubs. To operate a radio station, just like in other countries, you have to pass an examination. There are two kinds of amateurs: those who are licensed to operate radio stations but don't have personal calls, and those who have callsigns. To get a personal license and a callsign you have to be at least 18 years old. Therefore, even well-trained youngsters are limited to working through radio clubs, using the club's call, under the supervision of a fully licensed amateur. Even adults in the first stage of their ham activity start by being an operator at a club.

***Photo A.** Joca YU1JS and his wife Svetlana YT1JJS in Ripanj.*

Every club has a name. The most favorite namesakes are Nikola Tesla and Mihailo Pupin, two famous native sons who made important contributions to electrical science. If these two names are already taken in a locale, then a new club will go for a geographical one. Many hams and radio clubs have huge towers and antennas, and there don't seem to be any restrictions or zoning laws whatsoever.

"The economic situation in the country has deteriorated because of the war... The sales tax, for example, is 26%..."

Every amateur has to be a member of a club and every club has a fully equipped radio station. Those who have personal callsigns and can afford to buy their own gear and set up a station at home often involve members of their immediate family in this hobby. I saw several husband/wife and parent/children teams. In most cases the husband, or father, was the more advanced in the family, but there were also instances where husband and wife had licenses and achievements at the same level.

The Radio Amateur Association of Yugoslavia, a member of the IARU, is very well organized. There are many kinds of activities, both in the numerous clubs and by individual hams. Years ago, the YU hams had the best equipment in eastern Europe because they had more freedom to travel. Thousands of Yugoslavs worked in western countries, especially in West Germany, and they could afford (and had the chance to buy) all sorts of modern appliances.

In recent years, however, the economic situation of the country has deteriorated because of the war in Bosnia and the blockade that followed. The sales tax, for example, is 26%. These days, there are very few dealerships selling radio equipment. Most of the gear, made in Japan, is brought in by occasional travelers and is very expensive.

In Yugoslavia, there are six categories of license, A being the highest and F, the lowest. The maximum allowed power is 1.5 kW; on the WARC band and on six meters, only 300 watts is permitted. The test for the A license requires code operation at 20 wpm, and the A hams have allband privileges. The no-code E licensees can use a maximum of 30 W on two meters and 70 cm.

I used Belgrade as headquarters on my trip. At the YU1IOP radio club there, among the many hams I was fortunate enough to meet were two couples: Lidia YT1LID and her husband Dragan YT1SDV; and Mira YT1MIR and her spouse Uros YU1EG.

***Photo B.** Toma YU1AB and his wife Sladica YU1SL in Valjevo.*

Photo C. Rade YT1FRR and his wife Cica YZ1DTS operate on the 2m band in Kragujevac.

While in Belgrade, I went to see Elmax, a repair shop specializing in amateur radio equipment. They have gear made by Kenwood, Yaesu, Icom—even some vintage Collins transceivers. They also build new equipment on special order: I saw a very nice 1 kW amplifier. The shop's owner is Max Maksimovic YU1MM; his wife is Rose YT1NZN. Their shop is a meeting place for amateurs with or without any business to conduct.

Belgrade is also the home of Buda YT1RBB, his wife Jela YT1EYL, and their daughter Jasmina YT1RYL. All three have VHF licenses and operate only on 2m with a homemade 25-watt amplifier. They live on the ground floor of a 16-story building, where the coax cable from their shack to the 12-element homemade yagi on the roof is 247 feet long.

In the village of Ripanj, where we went next, there is a couple living on a small farm: Joca YU1JS and his wife Svetlana YT1JJS (**Photo A**). Their daughter Dragana, who died in a car accident, was an operator at the YU1AIE club station in nearby Lapovo.

In Valjevo, about 62 miles southwest of Belgrade, we met Toma YU1AB, ex-YU1DZ, and his wife Sladica YU1SL (**Photo B**). It is hard to believe that Toma has only a multiband dipole, and a 17-element yagi for 2m, because he is on the DXCC Honor Roll No.1; *CQ* DX Honor Roll; WPX Honor Roll; and has the 5BDXCC, 5BWAZ, etc. The reason is that in Lajkovac, in his parents' house, Toma has a big station feeding 1 kW to a 4-element tribander on the top of his 56-foot-high tower.

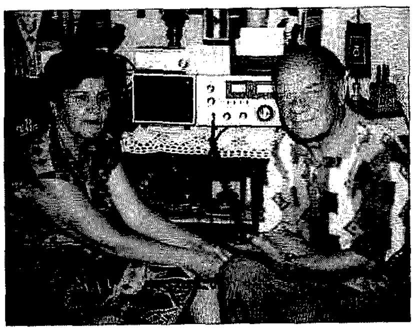


Photo D. Radmila YU1GR and her husband Ivan YU1HA, in Kragujevac.

Toma is the president of YU1GTU, contest call YT1L, the radio club in Lajkovac. They use 1 kW and have 338 countries confirmed. We also met Slavko 4N1RS, Dusan YT1DL, Voja YT1DOS and his son Milan. On top of the club's 60-foot tower there is a 3-element yagi for 10-15-20m, an 11-element yagi for 2m, and a couple of wire dipoles for 15 and 80.

One morning, Rade YT1FRR, his wife Cica YZ1DTS (**Photo C**), and Milan YZ1PWO picked me up at my hotel. We drove to Kragujevac, population 180,000, about 65 miles south of Belgrade. There we visited Ivan YU1HA, president of the local radio club YU1EFG. Ivan, a retired sergeant, was a partisan during World War II. His wife Radmila YU1GR was licensed in 1968. They have a good station, with a ground plane for 10-15-20 meters and a wire dipole for 40 and 80. Both work only on CW and have impressive records. Ivan is a contester, with 700,000 QSOs, 361 countries confirmed, and 1,384 awards; Radmila has 289 countries for her DXCC (**Photo D**).

I also met Mile YU1QQ and his son Nikola while they were operating from the YU1EFG club station (**Photo E**), as well as Ratko YU1NR and his XYL at their home in Kragujevac (**Photo F**).

Ivan and Radmila have a second house in Knic, about 13 miles from Kragujevac, with a homemade 70-foot tower, a 3-element cubical quad for 20m, and a 4-element quad for 10 and 15. A second tower, 33 feet high, has a 5-element yagi for 6m and a 21-element yagi for 2m. They also have a 2-element wire beam for 40m directed to the US, and a horizontally-polarized Delta loop for 10 to 80. They use 1.2 kW and have lots of homemade equipment. Now maybe you understand where those 700,000 QSOs have come from?

In Jagodina, I found Miodrag YZ1MCM, who works in the local electrical cable factory, his wife Ana YT1ECA, and their daughters Monica YT1ECM and Isidora

Photo E. Mile YU1QQ and his son Nikola operating at the YU1EFG club station in Kragujevac.

YT1FCI (Photo **G**). All have VHF/UHF licenses and operate on the 2m band, which in Yugoslavia extends from 144 to 146 MHz.

Rade 4N1RK drove Miodrag YZ1MCM, Zoran 4N1EV, and me to Cuprija, where we saw Mile YU1MI. A salesman of electrical and electronic equipment, Mile uses a computer for packet, has a 100-watt transceiver, and is building an amplifier. On his 50-foot homemade tower, he has a 3-element yagi for 10-15-20m; two 11-element yagis, one vertically-, the other one horizontally-polarized; and 3 dipoles for 80, 40 and 20m. Mile has an A (Extra) class license and a nice QSL. His daughter Dragana YZ1NZC has a VHF/UHF license for 2 meters and 70 cm.

In Krusevac, population 42,000, I found the YU1ADO radio club. Its secretary is Lila YZ1SL, who received her B license in 1995. She works at the post office. The club has 80 members. They use a TS-430S with an 800-watt Yaesu FL-2277B amplifier. The antennas are: a Delta loop for 80m; a dipole and an inverted V for 40m; and a ground plane for 20. The club has about 200 countries toward their DXCC.

I also saw Lila's home station, YZ1SL. Her family are refugees from

Photo F. Ratko YU1NR and his XYL (no personal call) in Kragujevac.

Photo G. Miodrag YZ1MCM and daughter Monica YT1ECM in Jagodina.

Bosnia, where she was X5SL. Her husband Saki works in a metallurgical factory—he used the X5SV call, with the controversial X5 prefix, in Serbia. Their son Andrej is in high school, and their daughter Aleksandra is in college studying economics; both have class C operating licenses without personal calls. They work on SSB and CW with a small transceiver and a dipole for 80m (**Photo H**). [Note: The X5 prefix used by the hams on the Serbian side of the divided Bosnia-Herzegovina is unofficial. It will be used until the status of this disputed land is clarified and an official prefix is assigned.]

I finally got to Kraljevo, where the first hams I visited were Rate YT1EKR and his wife Goca YT1RGA (**Photo I**). Both have been enthusiastic CB operators for many years. Now they have no-code E licenses without personal callsigns, and with 30 watts and a 7-element vertically-polarized yagi they also operate on 2m.

About 6-7 miles from Kraljevo is the small village of Vitanovac, where one of the greatest stations I have ever seen is located. It belongs to Hrane YT1AD, the

Photo H. Son Andrej (no personal call), mother Lila YZ1SL, and father Saki X5SV in Krusevac.

Photo I. Rate YT1EKR and his wife Goca YT1RGA of Kraljevo.

president of the Radio Amateur Association of Yugoslavia. Hrane is in the import-export business and lives part of the time in Moscow, Russia, where he is RV7AD. Because he was at a ham meeting in Kraljevo, his brother Milovan YT1IM showed the whole setup to me and Simo 4N1SM, who had also come along. The station has a couple of transceivers and linear amplifiers—nothing unusual in the house of a very rich man. Milovan, Simo and I tried to figure out the multitude of towers and antennas. On a 122-footer, there is a 7-element yagi for 10m; a 4-element yagi for 40m; and a 6-element yagi for 10m fixed in the direction of the US. On a 99-foot tower, there are two yagis for 2m, one horizontally-polarized, the other vertically-; and a 6-element yagi for 20m. On another 99-foot tower, there is a 6-element yagi for 15m; a 3-element yagi for 12-17-30m; and a 6-element fixed yagi directed toward the US. Near the house, on a mast, is a 6-element yagi for 6m. All cables are run underground, despite the long distance from the towers to the building. There are also a bunch of wire antennas we could not figure out.

I met many hams on my trip. I'm sure that among them there are many more who have licensed amateurs in their families. I did not always ask them about this. Those who supplied such information were proud and happy that their hobby and interests are shared by the people closest to them. And that's the way it should be.

73 Review

Timewave Technology's DSP-599ZX

Excellence in digital signal processing.

Jim Kocsis WA9PYH
2217 Hidden Oaks Ct.
South Bend IN 46628

Timewave Technology, Inc.'s new DSP-599ZX is an audio digital signal processor (DSP) made to improve communications in many different modes by reducing noise and interference. It uses an A-to-D converter to digitize the incoming audio signal, runs the digitized data through software algorithms to eliminate all but the desired signals, and then outputs the remaining digital data through a D-to-A converter and audio amplifier.

Why did I want a DSP?

I had read several product reviews on available units and tutorial articles on how they work. After reading about it, and seeing how powerful DSPs are in applications where I work, I decided I could make good use of one in my DXing, CW and future satellite activities.

The first thing I noticed about the 599ZX was the high quality of construction. It is very solid and heavy. Digital encoders are used for two of the three variable controls. This is nice because they won't get dirty and become intermittent like typical potentiometers. The third knob is the volume control—it is a common potentiometer. The display window is a 2-line by 16-character backlit yellow-green LCD. Additional individual LEDs are green, yellow and red. The unit is compact—approximately 8 x 9 x 2 inches, small enough that I set mine on top of my HF rig, so the controls are close when they need to be adjusted.

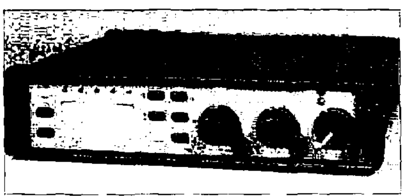


Photo A. Front view

All input and output connections are via phono jacks, so you won't need to buy any high-priced or hard-to-find connectors. You can also use the two DIN connectors that provide access to the same signals. The 599ZX has connectors for two radios. Via the front panel you select radio A or radio B and audio output A or B. Having two channels that are selectable from the front panel eliminates having to unplug and plug connectors when switching between radios. The power connector is supplied so you don't have to run out to get one. According to the manual, the unit requires 1 amp at 12 VDC for proper operation, but I measured .65 amps at normal volume levels. They probably specified 1 amp to make sure the voltage doesn't droop when the volume is set to high levels. I powered my 599ZX from my HF rig's power supply since it is rated at over 20 amps and one more amp of current won't even be noticed.

So how do you operate this little gem?

The manual is very well organized. It has a Quick Start section so you can begin using it immediately, and separate chapters on CW, voice, data and test modes. I highly recommend reading the *entire* manual first so you can determine all that this very powerful unit can do. Be aware, though, that there is a lot to this unit and you won't remember how all the functions work by reading the manual once. The manual I received had occasional quirks—extra words, awkward sentence structure, etc., but this didn't keep me from using any feature. The manual was three-hole-punch pages held together by prong paper fasteners. As I turned the pages, the manual literally fell apart in my hands. I bought a 50-cent three-ring binder with fold-down tabs and a clear front cover (it would have been nice if Timewave had supplied this). Pictures are plentiful, showing which button or control to adjust.

CW—where the unit really excels

The 599ZX has a spot feature that you use to match the tone of the desired signal to the center of the bandpass filter.

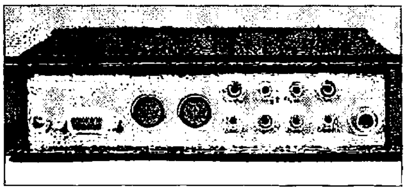


***Photo B**. Rear view (Photos by Tim Ciesielski.)*

You then narrow the filter and all signals outside the passband disappear. Disappear is the correct word. They are not reduced—instead, they actually disappear! You must adjust the level of the spot signal so that it doesn't get covered up by other stronger signals or so that it doesn't mask the signal you are trying to hear. This takes a few button pushes but is not difficult. Other brands of DSPs don't offer this spot feature. Without it you could easily eliminate the signal you are trying to isolate. It is a definite plus! The bandwidth can be adjusted down to 10 Hz. This is too narrow for normal CW operation—about 150 to 200 Hz is as narrow as you can go and not have the individual dots and dashes start merging. Don't confuse the ringing associated with typical audio filters. This filter doesn't ring. The best description I can give is that each dot (and dash) doesn't start instantaneously, but instead turns on and off slowly. At high speed and narrow bandwidth, it is hard to tell when one dot (or dash) stops and the next one starts. The 10 Hz bandwidth is useful for low speed CW in applications such as moonbounce where signals are very weak. If the speed is slow enough you will be able to discern the individual dots and dashes.

Even though you have adjusted the bandwidth as narrow as you can for the speed, sometimes there is still one station too close to the desired signal to be eliminated. For this situation the 599ZX has one more trick up its sleeve—it's called the tunable notch. This is a very deep notch that you can move anywhere to remove a narrow band of frequencies. You simply tune it until the interfering signal disappears. Of course, the notch center frequency is displayed on the front panel along with the bandwidth. For this feature the bandwidth is shown as a number from one to five instead of displaying the notch width in cycles. The manual didn't say what bandwidth corresponds with what number, except that one is narrow and five is wide. Advancing this number from six to nine results in a dual notch that has two notches that are 180 Hz apart. The manual claims that the dual filter is useful for eliminating interference from data signals. I don't know what data signals they're referring to, but there were two definite deep nulls as I swept the center frequency near the desired signal. The display indicates if you have the single or dual notch filter selected by showing an S or a D.

Tone reduction

This feature comes in very handy when someone decides to tune up on top of a voice signal. The Tone Reduction should be relabeled Tone Elimination since the tones are gone, not reduced! To check it out, tune in WWV on AM with the tone reduction off. You will hear the usual tone every second. Now turn on the tone reduction. The tones are gone! The same thing happens when you're using SSB and a tuner-upper comes on. All you hear is a very short ping when the interfering carrier comes on, and then no more carrier! Very neat! Just eliminating the tone is neat in itself, but there's always the problem of the receiver's AGC weakening the desired signal if the carrier is stronger than the SSB signal. The 599ZX overcomes this problem by using audio AGC to bring the audio back up to a constant level. It was really neat to be able to hear an S9 signal (before the carrier appeared) below a 10dB over 9 carrier! Imagine that the DX station you're talking to is running S9 at your QTH (not an uncommon level during this sunspot cycle minimum). All of a sudden a carrier comes on at 10 dB over 9. The S-meter isn't following the SSB station's voice because the carrier is stronger than the DX station's voice! You push Tone and the carrier is gone. You push AGC and the DX station's audio comes right back up to where it was before the carrier appeared. Nice, very nice! I have Variable Passband Tuning on my rig. With this control you can adjust the IF passband to reject an interfering signal. Sometimes it helps with an interfering carrier, sometimes it doesn't.

The tone reduction in the 599ZX always works.

Noise reduction

The Noise Reduction feature is not the panacea that I had envisioned. If a signal is weak, it definitely helps. Noise reduction is just that: The noise is reduced, but not gone. Most weak signals are made more readable when activating this feature. However, the signal must be just above the noise and not in it. The audio is a little more harsh (not distorted) when using Noise Reduction. However, if the audio is distorted, the noise reduction actually makes the audio worse. My guess is that the software doesn't recognize distorted audio as speech and removes parts of it, causing even more distortion (all the more reason to keep your transmit audio as clean as possible!).

I tried the noise reduction feature on 2-meter FM. Signals that were barely above the noise were made more readable. They too were made a little harsh-sounding by this feature.

I also tried the noise reduction on lightning static crashes. It did help some on SSB, but apparently there is very little you can do to fight those large bursts of energy.

AM line-noise reduction

This feature is absolutely amazing! I occasionally do some DXing on the AM broadcast band and even though power lines in our neighborhood are buried, I am sometimes plagued by 60 Hz line noise. This noise completely covers weak signals and is at best a minor annoyance on all but the very strongest signals.

To test this feature, I tuned in a weak signal on the AM broadcast band that had so much 60 Hz noise on it that spoken words could not be understood. Activating the AM Line Noise Reduction feature produced a perfectly clean signal. There was no sign of 60 Hz line noise. This feature is different from the Random Noise reduction described above. It can be set to either 50 or 60 Hz (user selectable) and only removes noise pulses at the selected frequency. The manual notes that this feature won't work on SSB, and it doesn't, but there's no explanation why.

Data modes

There is not a single mode but many different ones. They include RTTY, AMTOR, PACTOR, G-TOR, HF Packet, CLOVER, SSTV, WEFAX. I did not try any of them so I can't tell how much the 599ZX improves operation—but if operation in the other modes is any indication, the 599ZX will really help in these.

Test mode

This mode reconfigures the 599ZX into several different pieces of test equipment. They include a sine-wave generator, a two-tone generator, a peak and true RMS voltmeter, and PL (CTCSS) decoder/encoder.

"All you hear is a very short ping when the interfering carrier comes on, and then no more carrier! Very neat!"

The sine-wave generator produced a very clean sine wave on my oscilloscope. The level and frequency are both adjustable and are displayed on the LCD.

The two-tone generator produced the two tones that can be used for transmitter adjustment. The level is adjustable.

A peak and true RMS voltmeter are available simultaneously. The range is limited to 2000 mV (2 volts).

The PL decoder is an interesting feature. I connected the 599ZX to a 2-meter rig and began kerchunking the area repeaters (and yes, I identified with my call!). The unit will display the PL frequency in Hz and the level in millivolts. The 599ZX can be used to determine the PL frequency of a private repeater, providing that you can hear stations on the input or if the repeater transmits its own PL. The 599ZX can also generate PL tones. Since most VHF and UHF rigs now come with PL (some can even detect the PL frequency of the transmitter), the only uses I can see for this feature are (1) your rig's PL has failed; (2) you're using an old rig without PL (admittedly clunky and expensive—but it would work); or (3) you need PL to access a 10-meter repeater with your HF rig.

These features are interesting but I don't know where or when I would use them. However, they are there if you need them.

While I was shopping for a DSP I found out that one of the other brands offered an audio spectrum analyzer function when coupled to a PC. I would have expected the 599ZX to include this function since it is the most expensive unit available. I would definitely trade the AC voltmeter and tone generator functions for an audio spectrum analyzer. Most people have an audio generator, oscilloscope (to set the level) and frequency counter (to set the frequency), but how many of us have a spectrum analyzer? I have access to one at work, but most hams don't have one, either there or at home. I hope software upgrades will include this option.

Low-pass/high-pass filter

The filter high-pass and low-pass cutoff frequencies are individually adjustable. They were most effective when the low pass was set to 3000 Hz and the high Pass to 300 Hz. The manual said that they could be used in place of a SSB filter. I adjusted these controls in an attempt to reduce some of the interference from nearby stations when using SSB, but audio DSP is no substitute for a good SSB filter in the receiver's IF. My HF transceiver has IF shift and this does help in many situations.

DSP in the work environment

I work in an aerospace test laboratory where we do vibration testing, among other things. Vibration testing consists of putting the test item on a shaker (very similar to a speaker but much larger). The shaker is driven by a large amplifier (approximately 50,000 watts) over a frequency range of 5 to 3000 Hz. Vibration sensors are attached to the test item at locations where parts may go into resonance at certain frequencies. These sensors are not frequency sensitive and return signals from the vibration frequency, rattles, fuel or air passing through the test item and any other source of noise.

During testing we sweep the frequency of vibration over the 5 to 3000 Hz range. We plot the outputs of the sensors vs. frequency to see where certain areas or parts go into resonance. Very often the rattles, fuel and air noise completely cover the vibration signal. To filter out all this extraneous noise we use DSP tracking filters. They have a moving narrow bandpass window that tracks or follows the excitation frequency. Without them all we can see is noise—no signal is visible. With them we are able to identify very weak signals buried deep in the noise. At times the signal can be as much as 20 dB below the noise!

It's worth it

At $370, the Timewave Technology 599ZX is the most expensive of all DSPs available, but you're getting your money's worth and a lot more. The 599ZX has the fastest processing time, so there is no delay in output when you tune the dial. You listen in near real time (18 ms). The six memories are a definite plus—you can switch modes at the push of a button instead of having to adjust many knobs hoping that you have them all set properly. It is also very nice having all of the values and the mode displayed on a backlit window rather than trying to figure out the settings by looking at the pointer on a knob. The 599ZX has provisions for connections to two radios—a definite plus if you plan to use the DSP with more than one. There is no need to switch connectors—you just push a few buttons to switch radios.

I am very pleased with the DSP-599ZX. In several weeks it has enabled me to make DX contacts that would have been impossible without it. Other contacts that would have been difficult without it were made much more enjoyable. Every feature that I was able to test worked as stated in the manual. There were no operating quirks or compromises. The design and operation of the unit was well thought out in every area. For further information, contact Timewave Technology, Inc., 2401 Pilot Knob Rd., St. Paul MN 55120. Phone (612) 452-5939; FAX (612) 452-4571; E-mail dsp@timewave.com. Their Web site is at http://www.timewave.com. Be sure to tell them 73 sent you!

The Atlantic Cable

Have you ever thought you've *had a bad day?*

L. VanProoyen K8KWD
8330 Myers Lake NE
Rockford MI 49341

Cyrus W. Field had *lots* of bad days. Thirty-five years old in the 1850s, and already retired from a successful paper manufacturing business, Cyrus was aimlessly drifting through life when he happened into conversation with one F. N. Gisbourne. Gisbourne had earlier been involved in an unsuccessful cable laying project: installation of a cable from Newfoundland to New Brunswick, part of the circuit needed to link Cape Race (Newfoundland) to New York. Linking Newfoundland with New York would speed up late-breaking news to (and from) Europe by a couple of days, Cape Race being the last North American port of call for ships headed to Europe across the Atlantic.

Gisbourne was trying to resurrect his project (the undersea part, under the Strait of Cape Breton) with new money, and Field was a possibility. No one as yet knew how to bridge the Atlantic with a cable. As it happened, their conversation about money drifted to the more frivolous, settling on a discrepancy over the true distance between Newfoundland and Ireland. Cyrus considered the discrepancy trivial, but the conversation got him thinking, "Why not a cable all the way?" Armed with this idea, Cyrus soon launched into a twelve-year series of (mis)adventures that was to ultimately end with laying the first Atlantic Communications Cable.

Early submarine cable development

By the time Cyrus began organizing his cable-laying plans, considerable development of undersea cables had already been done by the British, driven by a desire to link England with the rest of Europe. They had the best facilities of the time for production of a suitable cable, as well as hard-earned experience and capability instructed through several failures in laying cable links between Ireland and England, and across the Straits of Dover.

The first successful cable-laying across the English Channel was completed by 1850, but the cable soon failed, suffering from abrasions caused by the Channel's gravel bottom. By 1853, the British had overcome most such problems with the development of a lead-coated, resin-insulated cable, as shown by the success of several operational links between England, Ireland, and the rest of Europe.

> ***"With over a million bucks spent, they finally had the strait successfully bridged by July of 1856. Only one problem—the Morse system wouldn't work!"***

Further reinforcing Field's plans was new information about the topography of the Atlantic floor, released by the US Navy. The naval survey revealed that the ocean floor along the proposed cable route was much more regular than previously thought, making the task of cable-laying easier than expected.

The Newfoundland and London Telegraph Co.

On May 6, 1854, Cyrus Field organized the Newfoundland and London Telegraph Co., Inc., with the aid of his friend, Peter Cooper, and other well-off New York investors. The company initially raised $1.5 million (and a pledge of support from Newfoundland) for starting their first attempt at laying an Atlantic cable. (At the time, they believed this money would finance the entire project... and that only one attempt would be required.)

Cyrus left almost immediately for England to initiate manufacture of the cable. This project went to mid-1855 when Cyrus, now armed with the wire he needed, turned up to lay the first section of cable.

Remember the Strait of Cape Breton?

Spanning this 55-mile stretch was probably an excellent introduction to how things were to go: The cable broke within two miles of shore, splices also subsequently broke, an uncooperative ship's captain had his own ideas of the proper route for the cable, and, finally, a storm forced the crew to abandon the project with over forty miles of cable down. Cyrus and company were forced to regroup for another try in 1856. With over a million bucks spent, they finally had the strait successfully bridged by July of 1856. The only problem? The Morse system wouldn't work!

Having started with little knowledge of communication systems just three or so years earlier, Field was rapidly becoming an expert in the subject. He was aware of earlier work in signaling by the Germans and particularly a system developed by the British Professor William Thompson (probably better remembered by his later title, Lord Kelvin). Cyrus adopted Thompson's system for the Strait of Cape Breton link and it worked. It was complicated, based on a sensitive galvanometer detector directing reflected light in a Morse-like code to an operator who in turn translated the reflections into text, but it worked. Cyrus hoped it would also work over a 2,300-mile cable.

The Cape Race to New York link was now essentially complete. That was the good news. The bad news was with only 2,300+ miles to go across the Atlantic, the Newfoundland and London Telegraph Company was bankrupt.

The Atlantic Telegraph Company of Great Britain

Cyrus had spent a good deal of his own money and a lot of his friends' getting this far, and his search for more "sports" in the US was being hampered by his critics. Undaunted, Field set off for England to gain additional financial support, and by the end of 1856, he had secured British backing of more than $2 million (a lot of money for the times) and organized the Atlantic Telegraph Company of Great Britain.

Back in business, Cyrus and his original friends (The Newfoundland and London Telegraph bunch) immediately set out to pick up where they had left off. By August, 1857, he pushed off from Ireland, laying cable toward Newfoundland. After four days and 350 miles, the cable snapped in two and half a million dollars went down the drain.

At this point, it was obvious that he needed a new cable-laying method. The scheme these guys came up with, though, was unique. They decided the best way was to use two ships, starting in mid-Atlantic, one headed for Ireland, and the other, Newfoundland, each paying out cable en route. Cyrus got it all going by mid-1858 with the two ships and all (he had to convince his backers this would work).

After several highly embarrassing experiences, both ships returned to Ireland to regroup. This was an occasion probably only Field the undauntable would have been able to handle. He had to reconvince his backers, and indeed he did. Underway again at the start of August, 1858, the two ships headed toward their destinations. Without major event, each ship reached its destination after six days. The Atlantic cable was in. But was it?

A hero's welcome turns to rebuke

In the first week of operation the cable worked well, but by the end of the second week of August, 1858, trouble began. In the meantime, celebrations were the order of the day for the "Atlantic Cable Heroes," the type of activities Cyrus Field was adept at promoting. The culmination of this hype was to be the exchange of messages between President Buchanan and Queen Victoria on August 16th, but by the 16th the line was almost dead. In spite of this, the messages got through (after two days of trying).

While the line continued to work to some degree well into October of 1858, word was spreading about the problem. The ensuing outrage that followed from both sides of the Atlantic resulted in Field's lying low for a few months.

After the dust had settled, Field and his backers decided to blame the problem on "faulty cable manufacture" which led to the premature failure of the cable (the "dust" had included allegations of fraud and the like). No one really knew what actually happened, but one thing they all knew was that they were broke, and new money was hard to get. Weeks ran into months and on into years with Cyrus out beating the bushes, trying to raise more money.

Field went on without success for over five years, both in England and the United States. The Civil War was raging throughout America at the time, and it, on its own, generated some interest in the need for a cable. But even the British at the time were reluctant to spend more money on the deal, having been recently burned by another undersea cable fiasco (in the Red Sea).

The Anglo-American Company

In 1860, halfway through the project, Cyrus W. Field had been forced into bankruptcy. He had consumed most of his personal fortune and that of his creditors on the venture. There came a time, during the nadir of his financial woes, that he became the object of ridicule and public avoidance. Nonetheless, he had persevered, making countless trips back and forth across the Atlantic to promote his cable project until he finally succeeded.

After seven years, Field was again on speaking terms with his old buddies at the Atlantic Telegraph Company and most of the other investors associated with his Atlantic cable project(s). As the Civil War was drawing to a close, he and his colleagues recruited the use of a passenger ship, the *Great Eastern*, for use in cable-laying for a year. By July of 1865, they were ready for another go at laying an Atlantic cable.

In the usual Cyrus W. Field style, they departed from Ireland after much fanfare. One thing he never learned was to avoid publicity, but with all the experience this bunch had, they *had* learned to continuously test the cable while en route. They were also using the latest in undersea cable design which, unfortunately for Field, still had several years of maturing to go. As cable defects were detected, they reeled the cable back until each bad section was located; they then repaired the defect, and continued on.

With all going well and about two-thirds of the distance traveled, they somehow lost the cable. Ten days later, they found it... only to lose it again, this time for good—or so it seemed. Cyrus must have personally known the coiner of "Try, try again," because off he went to London again, to reassure his backers that he knew what he was doing—and he did it; again, he organized a new company (the Anglo-American Company); he reloaded the *Great Eastern*; and headed for Newfoundland, although delayed almost a full year.

"Day after day, night after night, her great pistons glided in their channels, and the cable poured over the stern without a hitch. At last they had learned how it was done!" —Harlow, *Old Wires and New Waves*.

On July 27, 1866, the *Great Eastern* entered Trinity Bay, Newfoundland, still in communication with their terminus at Valentia Bay, Ireland. The cable was good. The cable was in!

Upon securing the July 27, 1866, cable, Cyrus turned the *Great Eastern* back to sea to look for his lost 1865 cable. Armed with better grappling equipment than he'd had the previous year, he found the 1865 cable on September 5, 1866, spliced it, and brought it ashore at Trinity Bay on September 8. This second cable worked perfectly, and the world now had *two* Atlantic cables. (Oddly, this stunt did more to restore Field's credibility than the docking of the July 27 cable.)

After losing an estimated $10 million over the preceding twelve years, Field eventually paid back all of his backers and investors, made money for everyone associated with the venture, and was then able to retire as a great world hero. By 1875, using the technology Cyrus W. Field pioneered, virtually every populated continent of the world was linked via cable.

Number 36 on your Feedback card

TV/VCR Tuner Applications

Part Two of three—you may want to keep Part One, from last month's 73, handy.

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

Voltages developed for use with tuners must be regulated and heavily filtered to reduce noise and voltage variations. Noise and voltage variations can cause tuner frequency instability, since tuners are voltage-operated devices. Regulators such as the 7812 and LM317 work well in tuner power supplies.

The mixer and band control circuits operate on +12 volts. A pot attached to the +12 volt bus is used to provide an adjustable voltage of approximately +7 volts which is connected to the AGC terminal. The actual AGC voltage value is unique to the tuner and must be determined experimentally while listening to a signal. In operation, the AGC voltage may be varied with a pot and used as an RF gain control.

Tuner tuning is accomplished by providing a voltage which is variable from 0 to 29 volts. The 29-volt supply may remain fixed, but the voltage applied to the tuning pin of the tuner can be varied with a pot. The most satisfactory tuning resolution is obtained by using a ten-turn pot. The addition of a vernier knob to drive the pot is helpful. Even with vernier adjustment, the tuning can seem a little erratic. To smooth out the tuning action, a 1-µF capacitor may be connected from the tuning pin to ground. Although a larger capacitor value may be used, the voltage time constant could thus be made too long, allowing frequency adjustment overshoot should the tuning knob be moved too rapidly.

If the tuner has an AFT terminal, you can utilize the feature for fine tuning. If unused, the terminal must be grounded. To be used for fine tuning, the terminal may be connected to the wiper of a 5k pot. Voltage for the pot should be a low value not exceeding 2-3 volts. One end of the pot can be connected to a positive voltage and the other to ground or to -1 volt.

Construction

Fig. 1 shows the typical wiring and voltage requirements to support a TV/VCR tuner used as a frequency converter.

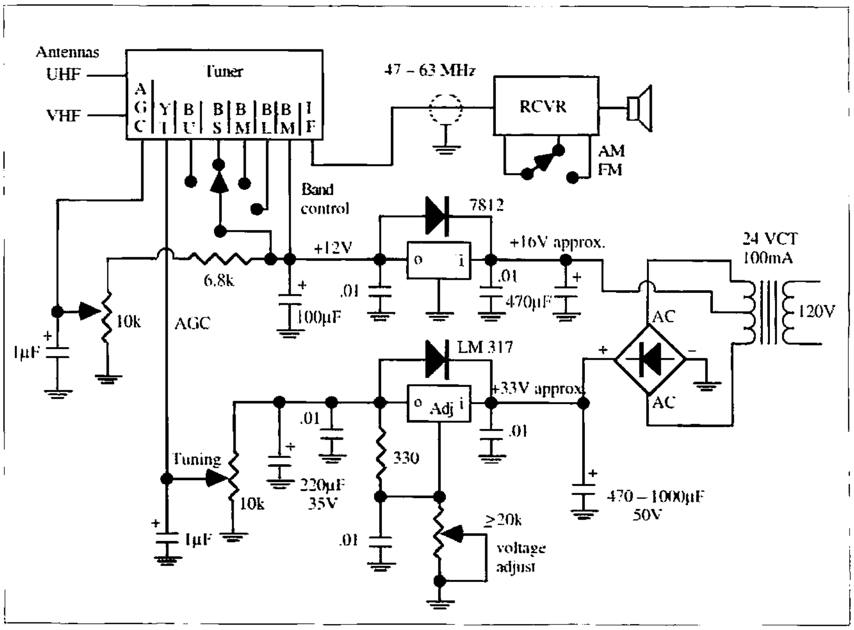


Fig. 1. TV/VCR tuner as a wideband frequency converter.

Mechanical construction is not critical, allowing a lot of freedom for the builder to choose the mounting of the tuner, pots, switch, etc.

Although the regulators are operating well below their dissipation rating, I suggest that they be mounted against a PC board or onto a small heat sink. The objective is to reduce the tendency for a voltage shift as a function of heat rise.

Dial calibration

After the converter is operating and the IF established at a specific frequency, a "look-up" table may be constructed to

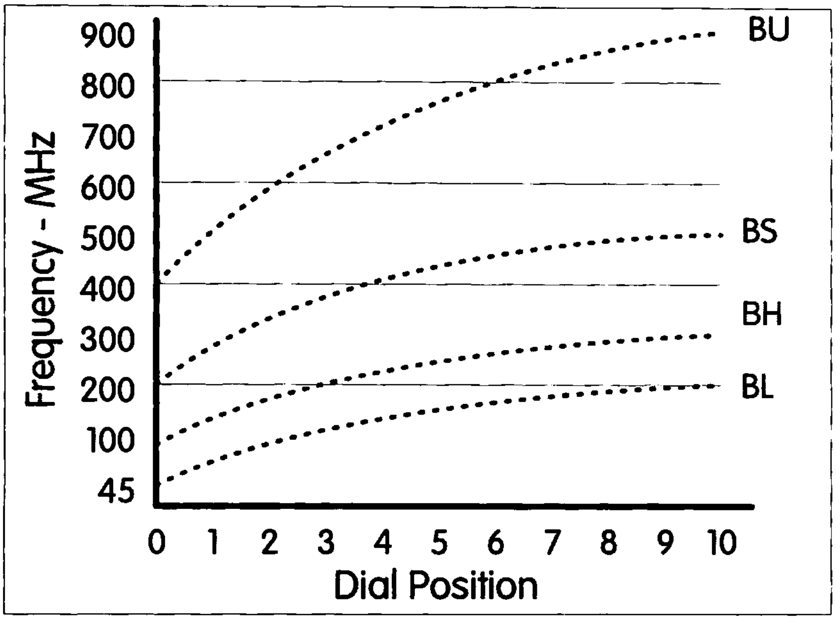


Fig. 2. Dial-to-frequency translation.

translate dial position markings to frequency. Specific frequency settings are then interpolated between known frequency calibration points.

Another method is to construct a calibration curve as shown in **Fig. 2.** Although the tuning curves are not linear, a straight line may be drawn between known frequency checkpoints. The readability resolution of the chart is set by the spacing between the X and Y coordinates on each axis.

Instead of using dial position markings on one of the chart's axes, you may use the tuning voltage for greater accuracy of frequency repeatability. TV/VCR tuners are quite reliable in their frequency resetability as a function of the tuning voltage. The use of a DVM to measure the tuning voltage to the 1st and/or 2nd decimal place is desirable.

If a signal generator is not available for determining frequency calibration points, known spot frequencies may be identified and logged. Signals such as cordless phone, FM BC, aircraft, public service, taxi cabs, ham bands, weather, TV audio channels and cellular phone can provide the necessary frequency references for rough calibration. In most cases it is sufficient to identify the band edges for each service.

"These tuners have one major drawback in mobile applications."

Take advantage of tuner availability—build a wideband frequency converter and tune in to the action taking place in the 45-900 MHz spectrum!

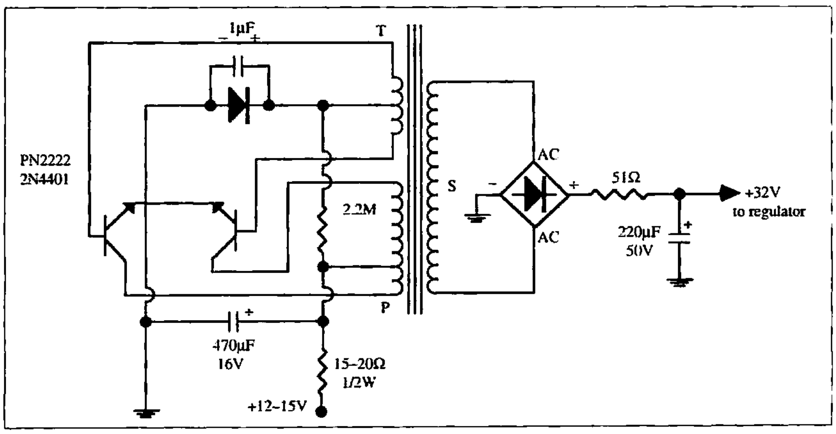


Fig. 3. DC-DC switching converter. All diodes are 1N4148. Operating frequency is approximately 56KHz. Transformer core: powdered iron, OD–0.4 to 0.5in., ID–0.125 to 0.150in. Windings: PRI–15T #26 enamel wound bifilar, SEC–30T #30 enamel, TIC–1T #30 enamel wound bifilar.

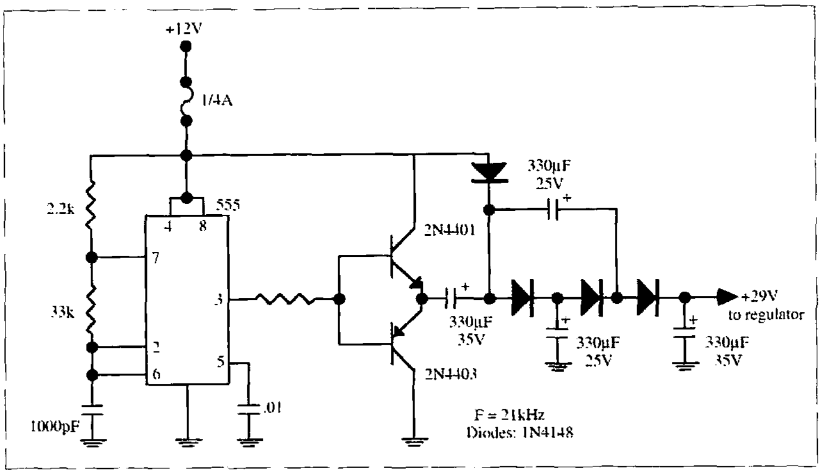


Fig. 4. 555 driving a voltage multiplier.

Mobile power

Because of their mechanical stability, TV/VCR tuners work very well in mobile applications. However, there is one major drawback that requires attention. TV/VCR tuners are voltage-operated devices and are not tolerant of changing voltage values. Therefore, mobile operation presents a real challenge for the experimenter. With semiconductors available, the challenge can be minimized.

The voltage requirements of a tuner are +12 volts and an ultra stable tuning voltage supply of approximately +30 volts. The +12 volts should be regulated because it is used to power the mixer/osc, band control and AGC circuits. Although most tuners prefer +12 volts, they will function without noticeable degradation down to about +10 volts. An automobile's electrical system is a suitable source and has a voltage value which can vary from about 12.6 to 14.7 volts depending upon engine speed. A standard 9 V to 12 V regulator could be used to provide stable voltage for tuner use except during the periodic loss in regulator headroom at perhaps a 12.6 V value when the battery terminal voltage falls. A simple zener diode regulator is normally sufficient and solves the problem nicely for the tuner.

The real challenge for mobile operation is the +30 volt requirement for the tuning voltage. There are several ways to generate a high voltage from a 12-volt supply. Two of the ways, a DC-DC converter and a voltage multiplier, are presented here. Perhaps the easiest method of obtaining the desired voltage is to build a DC-DC converter designed around a powdered iron core as shown in **Fig. 3**. Most any powdered iron core, except ferrite, will work in this application. Switching is accomplished by driving each transistor alternately into saturation. The core, being powdered iron, does not saturate easily. Therefore, the switching frequency is desirably high (approximately 56 kHz) in order to take advantage of a small core size and to aid in the ripple filtering process.

Another method of obtaining the high voltage is to utilize a voltage multiplier. But for a voltage multiplier to function, it must be driven with AC or a DC chopper circuit. **Fig. 4** shows a 555 IC used as a chopper driving a complementary pair of transistors. Working alone, the 555 cannot source enough power, but the transistors can. The transistors are driven from cutoff to saturation by the square wave output of the 555. There is little or no conduction overlap in the transistors, which results in little or no heat generation—therefore, a heat sink is not required.

With the AC voltage component generated by the chopper, the voltage multiplier will increase the output voltage to approximately 29 volts (which is marginal for tuning the high frequency end). It is difficult to obtain a higher voltage from the circuit shown, because only one voltage rail of the multiplier is moving, not two as would be the case with an AC source. Single rail switching limits the function to a maximum voltage multiple of three, minus losses.

Fig. 5 shows an LM317 regulator that is required to regulate the output of the +30 volt source. Adjustment of the regulator is critical in order to obtain the highest possible stable voltage. The correct setting is found during a battery non-charging condition when the source voltage is low. Pot R1 is adjusted to reduce the output voltage just enough to obtain output stability, which will occur when the voltage drop across the regulator rises to about 4 volts. Output voltage stability achieved by this method will be retained as the battery voltage rises/varies while under normal charge.

Because of mobile operation, all parts must be supported mechanically to prevent vibration damage. Heat-sinking, though, is not required since all parts are operating below their dissipation factor.

Next time: Spectrum analyzer, signal source, multifunction signal device. 73

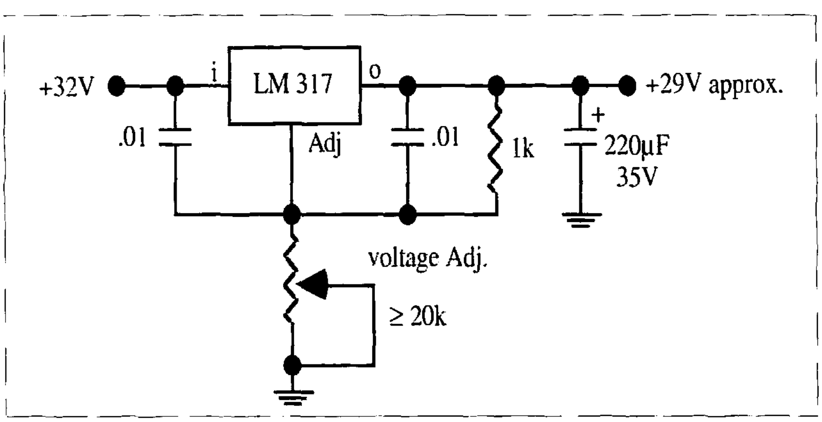


Fig. 5. 29-volt regulator.

Never Say Die
Continued from page 7

getting my 60-year membership pin next year.

Okay, now tell me where I'm wrong. Better yet, what do you propose be done and by whom to get our hobby growing like it is in Japan?

Bad Apples

A reader sent me a tape of K3ZO during a contest. What I heard defied all the accepted ideas of sportsmanship. Yes, this got me to thinking. What can be done about egregiously rude behavior on our bands? Jamming, bad language, and so on? Have you any ideas?

One basic problem is that when a nasty-tempered ham lets loose on the bands there are few, if any, repercussions. It is comforting to know that nasty-tempered people die much sooner than happy people, but they sure can spread a lot of misery while we're waiting for their nastiness to kill them.

Well, I tend to think in terms of solutions, so here's what I propose. How about *73* issuing a "Bad Apple" certificate to hams nominated for this award? The floor is open for nominations, so the next time you are assailed by some dirty rotten SOB on the air, why not nominate this turkey for this award?

Continued on page 49

Reviewing the Packet Scene: UK 1996

British Isles hams are ready to meet you!

Roger J. Cooke GB7LDI
The Old Nursery
The Drift, Swardeston
Norwich, Norfolk, UK
NR14 8LQ
G3LDI@GB7LDI.#35.GBR.EU

Obviously quite a few of you have read my article in the February 1993 edition of *Radio Fun*, judging by the response I've had by both packet and snail mail. It is gratifying to know that the UK packet scene is of such interest to our friends in the US. Many thanks for the comments and requests.

Some of the requests asked about packet addressing in the UK and whether a list of BBS was available. Updated lists are sent around the UK network every few months, and the amateur responsible for producing these lists is Brian G8ASO. He puts in a lot of work in compiling the lists and they are very useful. (*Ed. note: A copy of the current list may be obtained by sending a #10 SASE to UK Packet List,* 73 Amateur Radio Today, *70 Route 202N, Peterborough NH 03458 USA.*)

Just to explain the HR addressing: My full address is G3LDI@GB7LDI.#35.GBR.EU. Originally, we used an underscore and a number in place of the #35. Then we adopted a county coding. For example, I am in Norfolk, so that would have been NOR in place of the #35. However, to avoid confusion, and there was some, the # and a number representing each county was adopted. I see that this system is being used in other parts of the world, too. The subject of international HR addressing is an ongoing thorny one and an international standard would really be a great idea.

There have recently been lots of sysop messages debating the suggested change from the two-letter continental field to a four-letter one. This change was originally suggested by Tom Clark W3IWI, in order to avoid some of the anomalies that exist when forwarding intercontinental mail. However, there has unfortunately been considerable resistance against this change, especially over in Europe. Having been involved with HF forwarding since 1985, I thought the suggestions quite logical and a solution in some cases to the problems encountered in directing certain traffic. Convincing everybody that this is indeed the case is a different matter!

Using the BBS list should enable most to target mail to the county or area they desire in the UK. Obviously, if the full HR address is known, this won't be necessary. Targeting a bulletin, however, can be a real problem. There is a proliferation of @WWW bulletins, most of which are not relevant, or are out of date, by the time they reach the other side of the world. This problem can be helped with the use of the REDIST server for the FBB BBS. This server, written by Chris McMahon G6FCI, can provide four specific areas of coverage for a bulletin. These are *LocBBS*, *Local*, *Region* and *Nation*. The server has to be configured in the targeted BBS in order to work, but it is gaining popularity worldwide now.

LocBBS is the targeted BBS only. Local is a few BBS surrounding the targeted BBS, Region can be a larger area still, and Nation is obvious. The only disadvantage of this program is that a list of BBS with it installed, worldwide, is necessary to make full use of it.

HF forwarding and Satgate operation

With the poor propagation that we are at present suffering, my US link is only on 20 meters. I forward with Joe K1RQG, located in Bucksport, Maine, every day. This is the only Stateside link I have at present, but it is a good one. I have tried tests with West Coast stations, but despite good signals, the QSB on the polar route defeats packet totally!

If, for any reason, the HF route fails, then traffic for NA is sent up to Andrew

CLIVE DATA BASE COMMAND SUMMARY	
AFTER 30/03/91	Lists files installed on/after 30th March 1991
BYE	Quit working the CLIVE station
DOWNLOAD	Sends all selected files lo user
HELP	Sends this screen, as does ?
HELP AFTER	Sends help on the AFTER command
HELP HELP	Sends full help file for all commands
QTH	Sends information about the CLIVE station
SCAN XXXX YYYY	Search selected files for words XXXX or YYYY
SELECT 1, 2	Select files using file numbers
SELECT FT290	Select all files with the keyword FT290
STATS	Reports on contents of the database
TOPIC 3	Select topic number 3
TOPIC MODS	Select a topic by keyword
TOPICS	Lists what topics CLIVE has available
UPLOAD	Send msg lo disk (Leave a file/msg for SYSOP)
WHAT	Lists files in current topic
WHAT SELECTED	Lists all files currently selected
WHAT NOT	Lists all files not currently selected

GB7LAN in Lancaster for forwarding via his Satgate. This prevents undue delays occurring in NA traffic. I also run a Satgate, the second in the UK, and mail is split between us. This is how the mail is split:

GB7LAN serves the following areas *only:*
North America—NA NOAM
Central American countries—CEAM
Caribbean area—CARB
South America—SA SOAM
and parts of Europe via REQSAT server *only*—Iceland, Norway, Finland, Sweden, Denmark, Germany, Netherlands, Belgium, Luxembourg, Austria, Czech Rep., Slovak Rep., Poland, Spain, Portugal, Gibraltar

GB7LDI serves the following areas *only:*
New Zealand, Australia, Pacific Ocean—OC
Africa—AF AFRI by Satgate or HF if there is no Satgate route to the destination country
Asia—AS, ASIA by Satgate or HF if there is no Satgate route to the destination country
Middle East—MDLE by Satgate or HF if there is no Satgate route to the destination country

With the backup of my HF port, mail delays should be minimal, despite problems of propagation, and the mechanical and electronic failures that we all suffer from time to time.

There is another route to the US, also very fast, and that is the Lonny link. This is a New York/London wormhole. The New York end of the link is situated 66 floors up in Rockefeller Plaza in New York City. This link is provided by the NBC TV Employees Amateur Radio Club. The main sysop was Frank WA2NDV, who even named his dog Lonny! However, Frank has had to cease his sysop work and has now handed the torch to Tom NY2S. The Lonny node in Central London gives BBSs such as GB7HSN direct access into the US network. This enables users to have real-time connects with US nodes and even join in on-line conferences across the Atlantic. Access to the Lonny link is at 9k6 bauds. The sysop at the UK end of the link is Derek G1HSN.

UK linking

A lot of the UK linking is still at 1200 bauds, using two meters and 70 cm. However, there are several 9k6 links in place on 23 cm now, and experiments are being carried out by some on 64-kbit links. In Norfolk, we are at present setting up a full-duplex linking to the main local repeater by all the BBS, at 19.2 kbaud on 23 cm, to shift all forwarding off two meters and 70 cm, making life easier for the user. This is being achieved by the use of a very nice modem, capable of 38.4 kbaud, designed and built by Matthew Phillips G6WPJ and John Ferguson G8STW.

Licensing of BBS operation in the UK is also different. My GB7LDI packet BBS license is a variation on my full personal call G3LDI. We have to obtain a Notice Of Variation (NOV) to operate a BBS. Control of the issuing of these is maintained by the Digital Communications Committee (DCC) which was set up to avoid a proliferation of BBS operation, and also to maintain a negotiating body with the Radio Authority (RA), who control amateur licensing in the UK. Node licensing is controlled in the same way, and site clearance has to be obtained if unattended operation is required. These regulations are at present undergoing a complete review and the NOV is being rewritten. This will streamline the issue of NOVs and avoid the long wait that some have had in the past. In the UK, our two-meter and 70 cm bands are half those in the US, so a tighter control has to be maintained and band-planning is essential. There is a threat to parts of the 70 cm band now from the manufacturers of car alarms and security devices, which are being placed deliberately within the amateur band, along with commercial data links and radar. The sharing of the band is becoming a problem in which the amateur, having no vested financial interest, has little leverage.

By using the BBS listing you will now have a complete and accurate way to route mail to any part of the UK. Even if there is more than one BBS in a particular county, there should be no problem. Send it to any one of them and the correct home-BBS can soon be found. As long as you direct it to the correct county in the first place, this will save the sysop a load of hassle. However, if you have mail for Cornwall and you send it to a BBS in the north of England, the sysop then has to do quite a bit of research to reroute it.

CLIVE—a versatile database with a name!

CLIVE is the name given to a very popular database run by Colin G6WHL@GB7KLY.#19.GBR.EU

Currently the mailbox holds over 1300 files and is expanding weekly. You can obtain files from CLIVE with ease. First you want to know what files CLIVE holds which will be of interest to you, so you have to send a CLIVE REQUEST message to the database.

You have to tell CLIVE what TOPIC you are interested in. SELECT what part of that topic you want. You then ask CLIVE to send details on WHAT you have SELECTED. Then say BYE (control Z).

Example: If you want to know all the recipes containing either Chicken or Fish then do the following:

Connect to your local mailbox and type

SP CLIVE@GB7KLY

When "Subject:" comes up, type

REQUEST

When "Send your message, end with cntrl Z or /EX" comes up, type the following (on separate lines as shown below)

TOPIC FOOD
SELECT CHICKEN FISH POULTRY
WHAT SELECTED
BYE
^Z

It's that easy—CLIVE will send you a list of all recipes containing either Chicken or Fish.

The reason you SELECT CHICKEN FISH POULTRY is to cover any way that your subject may be stored. (Clive is clever and will sort things out to cover most combinations of your selection.)

The only lines you need to alter for any subject are:

TOPIC (the subject of your choice).

SELECT (the item of interest within the subject).

If you had chosen the TOPIC PACKET and SELECT BSX2 BSX

Clive would have sent you a list (and a few pointers to what you selected) similar to the one at the top of the page.

Now you can select which file you would like to see, so you have to send a message to CLIVE REQUESTing a file. You have to tell CLIVE the TOPIC (subject) from which you want a file downloaded. You then must SELECT the file

No.	Date	Bytes	Description of contents
38	18/08/90	7808	TNC2/BSX2 COMMANDS: A list of commands
39	31/08/90	4505	TNC2/BSX2 COMMANDS: A list of commands
40	31/08/90	4702	TNC2/BSX2 COMMANDS: A list of commands
45	17/09/90	3448	Modifying the BSX2 for STATE MACHINE DCD
48	01/10/90	1506	BSX2 DCD mod. The circuit diagram for file 45
92	03/03/91	3282	Linking DL and BSX TNCs for use as nodes
96	18/03/91	1030	BSX2 TNC mod for open OR closed squelch
CLIVE > BYE			
Thank you for using the database,			
I hope you find the reply useful.			
73, Colin, G6WHL@GB7KLY.#19.GBR.EU			

(or files) and ask CLIVE to DOWNLOAD the file (or files). Then say BYE ^Z.

OK, the TOPIC is PACKET and the file I want is the diagram for the DCD mod; if you look at the list above, that is file 48. So to download the file of your choice do the following:

Connect to your local mailbox and type

SP CLIVE@GB7KLY.#19.GBR.EU

When "Subject:" comes up, type

REQUEST

when "Send your message, end with cntrl Z or /EX" comes up, type the following on separate lines as shown below:

TOPIC PACKET
SELECT 48
DOWNLOAD
BYE
^Z

That's it. Clive will send you the file you have chosen. You can send for a selection of files with SELECT 48 92 96; there are currently 23 topics on the database.

Snippets

Other data modes are gaining in popularity in the UK. SSTV and FAX are used a lot, both on HF and VHF, using JVFAX, or something similar. Pictures can be made into BMP, GIF, or similar files and passed around on the air. Quite a few are to be found on the satellites.

TCP/IP is gaining in popularity, albeit rather slowly. There seems to be a tendency to shy away from this protocol, mostly because of a lack of information. To help with this situation, Ian Wade G3NRW has written a very good book, called NOSIntro, which explains TCP/IP

No.	Name	Content of Topics
01	BBSs	Bulletin boards & mailboxes on amateur radio
02	PACKET	Packet related files excluding BBSs
03	MODS	Mods to CBs, amateur, and PMR equipment
04	HUMOUR	Articles from Keighley ARS newsletter
05	SOFTWARE	Amateur related programs (sent as ASCII Files)
06	GENERAL	General interest—mainly for VHF users
07	VIRUSES	Description & cure of some common computer viruses
08	PRINTED	Writing, short stories, non-ham technical articles
09	COMPUTERS	Information and articles (other than programs)
10	REQFIL	1000s of files from UK BBSs via reqfil protocol
11	SPACE	Ariane, Galileo, Giotto, Mir, Voyager, Atlantis, etc.
12	ACORN	Acorn computers. BBC, Master, Archimedes, etc.
13	CLUBS	Clubs, societies, user/special interest groups, etc.
14	YAXPAK	News, previews, and reviews of the Yorkshire network
15	SYSOPS	SYSOP conference proposals, decisions, & minutes
16	ATV	Amateur television
17	LIFE	Views of life, the universe, and other things
18	MOBILE	Using/installing transceiving equipment in vehicles
19	LISTS	Lists for use with SCAN command, no download possible
20	MISCSOFT	Miscellaneous software—nontechnical
21	FOOD	A collection of recipes
22	ICOM	Modifications exclusively for ICOM equipment
23	YAESU	Modifications exclusively for Yaesu equipment

and also shows the user how to set up a system. It comes complete with a disk and is a good value for the money in the UK. I don't know if it is available in the US, but it would make a very nice present for any ham.

One of my HF forwardees, who visited me in the late 1980s prior to setting up his own BBS in Moscow, is Leo Labutin UA3CR. I forward every day with Leo, and have a very reliable path to him.

In Norfolk, UK, we have a yearly event on the last Sunday in June, the annual BBQ. It started off purely as a local packet BBQ but has grown over the last 8 years so that now we have over 100 people attending. It sometimes has an international flavour, too. John Bayes VK2SB, from Sydney, and Fred Wyatt VE7PL, from Victoria, have visited, along with their wives. If you are in the area of Swardeston, near Norwich, on the last Sunday in June, you will be most welcome.

High-speed data

Some experimental high-speed packet work is also going on.

Rob G1ZPU is currently working on a 10-Mbit (yes, *megabit)* 10-GHz link between GB7KHW and his system. Although the distance involved is only a couple of miles, it should be possible to prove the technology, leading to the possibility of linking hilltop sites at this unheard-of speed using simple and cheap equipment.

For example, the tx kit will work out at around £40, based on an ATV rx with mods for data. The rx will be nothing more than a cheap Amstrad or similar satellite rx which can be had for around ten pounds at the rallies. An LNB modded for 10 GHz rx will be about £30 (new) or £25 (secondhand). The rx will only need to have a baseband output for the raw video signal. For "video" read "data"! The communication medium is actually 4-wire ethernet. Speed can be anything from 1 Mbit/sec to 10 Mbit/sec. (100 Mbit would require modding the rx circuit even more, and also some serious tx mods, plus it's also pretty band-hungry, as the 10-Mbit link will want 20 MHz for a full duplex link—therefore, a 100-Mbit link will want 200 MHz!) Others have built 64-kbit links at 10 GHz for short point-to-point linking.

That just about brings you up to date with what is going on in the UK... 73 and happy packeting!

Is Your Mixer Circuit Mixing Like It Should?

It's not bad... it's just misunderstood.

John Pivnichny N2DCH
3824 Pembrooke Lane
Vestal NY 13850

Nearly every receiver, transmitter, transceiver, or transverter contains at least one mixer, yet this is one of the least understood circuits—and you will need to know about their operation if you want to build ham equipment. If you ask an old-timer how the mixer works, you'll probably get something about sum and difference frequencies. But what about the signal levels? What should they be? How can you measure them?

Amplifiers vs. mixers

Amplifier circuits routinely handle multiple signals by amplifying them equally without causing interaction between them. For example, two signals can be combined (added together) with a resistive combiner and then amplified as shown in **Fig. 1**.

Both signal a and signal b will appear at the output of the amplifier. If they are sine waves of different frequencies, then the two can be separated after amplification with frequency-selective filters. If the amplifier is operating properly, the two signals do not interact with each other. Each is amplified as if the other did not exist and no other signals are generated. In fact, if any other signal or noise occurs, it is frequently caused by improper operation of the amplifier, such as overdriving or flattopping, or by nonlinearities in the amplifier. The spurious signals generated by improper operation are called "distortion" because they distort the waveshape of the two signals.

A mixer circuit's purpose is to combine two signals so they *will* intentionally interact with each other. The two signals are multiplied in a mixer, while they are merely added in the amplifier circuit of **Fig. 1**. In a mixer, one signal is said to "modulate" the other. When two sine wave signals are multiplied together, additional frequencies are produced, consisting primarily of the sum and difference frequencies. See **Fig. 2**.

"Any other noise is probably caused by overdriving, flattopping, or nonlinearities in the amplifier."

Any circuit which partially or completely multiplies two sine wave signals will generate sum and difference signals of half the amplitude of the product of the amplitudes of the input signals.

All mixer circuits use this fact in one way or another. Practical mixers may do more than just multiply the input signals. They may provide some gain, output filtering, and "balancing."

The double balanced mixer

The two input signals of a mixer can be prevented from appearing at the output by means of a clever connection which "balances out" their effect on the outputs. A typical circuit for doing this is shown in **Fig. 3**. The circuit uses a well-known MC1496 double balanced mixer part. The inputs, labeled carrier and signal, can be applied as differential (push/pull) or single-ended (unbalanced) signals. For example, a push/pull carrier signal can be applied to pins 8 and 10 with .01-µF coupling capacitors. An unbalanced carrier signal would be applied to pin 8 with a .01-µF coupling capacitor and pin 10 bypassed to ground also with a .01-µF capacitor. The output is taken from pins 6 and 12 as shown. For operation from a 12-volt supply, the mixer is biased for 7.23 volts on the carrier inputs, 3.97 volts on the modulating signal inputs and 1.2 mA of current into pin 5.

The bias arrangement of **Fig. 4** is used. The outputs can be fed directly from 12 volts through an appropriate push/pull transformer as shown in **Fig. 3**. Outputs can also be fed with 3.9-kΩ resistors connected to +12 volts. The output signal is then taken from pin 6 or 12 by coupling with a DC blocking

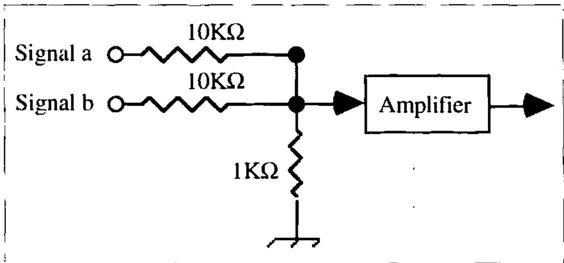


Fig. 1. Resistive signal combiner and amplifier.

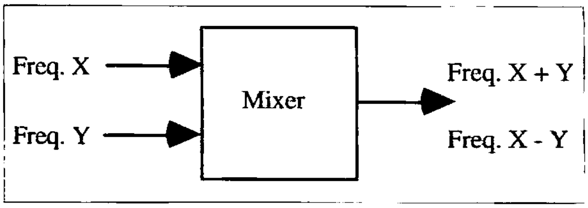


Fig. 2. Mixer diagram.

capacitor. For the frequencies in the HF range (3-30 MHz) a .01-µF capacitor is satisfactory.

Balancing of both the carrier input and the modulating signal input occurs because the collectors of transistors c and d are cross-connected to those of transistors a and b. If the circuit is working properly, only the mixing products will appear at the output terminal. Usually some type of filter circuit follows, to remove either the sum or difference frequency and allow the other one to pass through to subsequent circuits.

Test your mixer

How can you tell if this mixer is operating correctly? Suppose this circuit is used to mix a 5-MHz carrier with a 9-MHz modulating signal to produce a 4-MHz output in the 80-meter band.

You can check for a signal at the output with a sensitive wideband RF voltmeter. Some examples of RF voltmeters you can build are given in the references. The one shown in the photograph, known as a dBm meter, is available in kit form [reference 1].

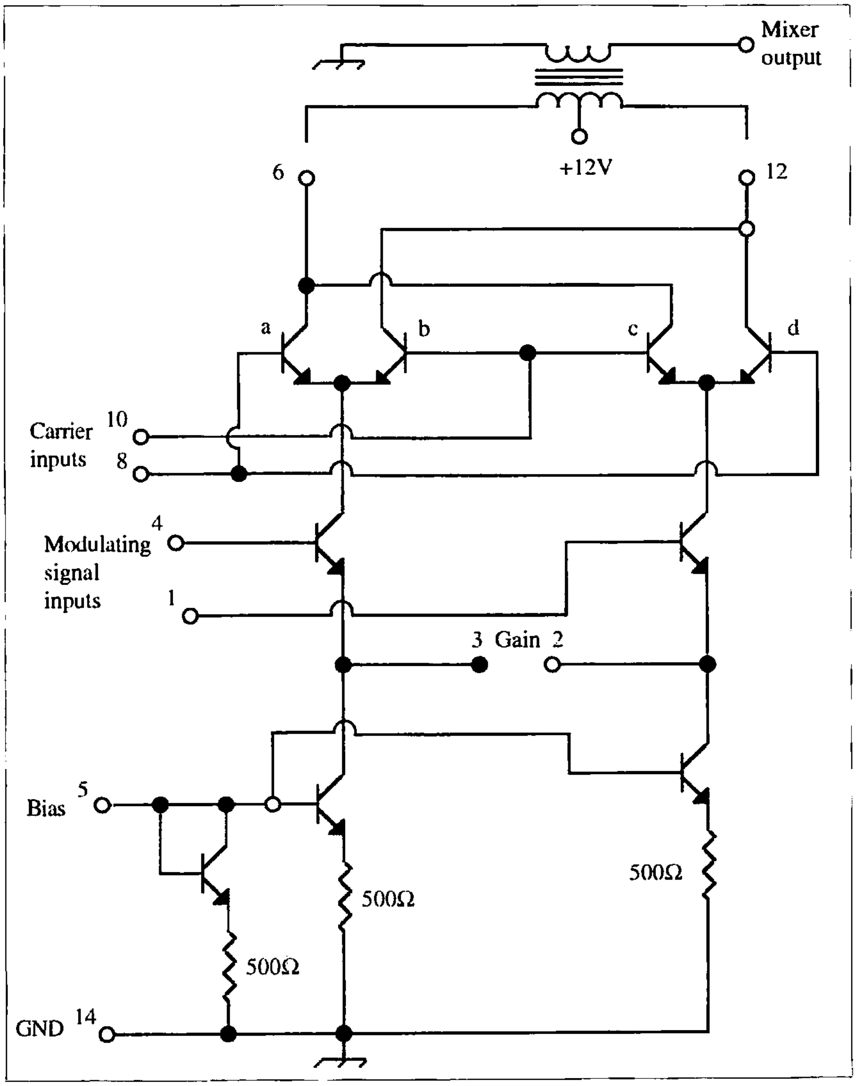


Fig. 3. MC1496 double balanced mixer circuit.

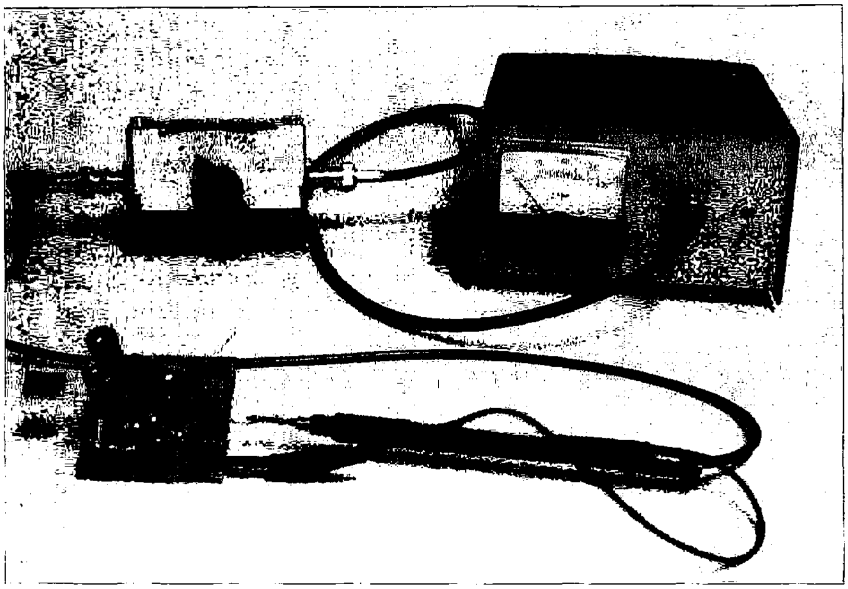


Photo A. Use of tunable filter ahead of RF voltmeter.

The first step is to apply one input signal (the carrier), and remove the other (the modulating signal input). There should be no signal at the output.

Just how weak the signal is at the output depends on how well the mixer circuit is balanced. A typical MC1496 part should have a carrier or modulating signal suppression of 40 dB or more. Temporarily unbalance the mixer by connecting a 10-kΩ resistor from pin 1 to ground. The output should jump up to a level two to three times the input level. Now remove the 10k resistor and the output should drop by 40 dB or more. For example, a 100mVrms output with the circuit unbalanced should drop to less than 1 mV when the 10k resistor is removed.

Now try removing the carrier input and applying the modulating signal. Temporarily unbalance the circuit by connecting pin 10 to ground with a 10k resistor. Check for an output signal and a drop by 40 dB or more as the 10k resistor is removed.

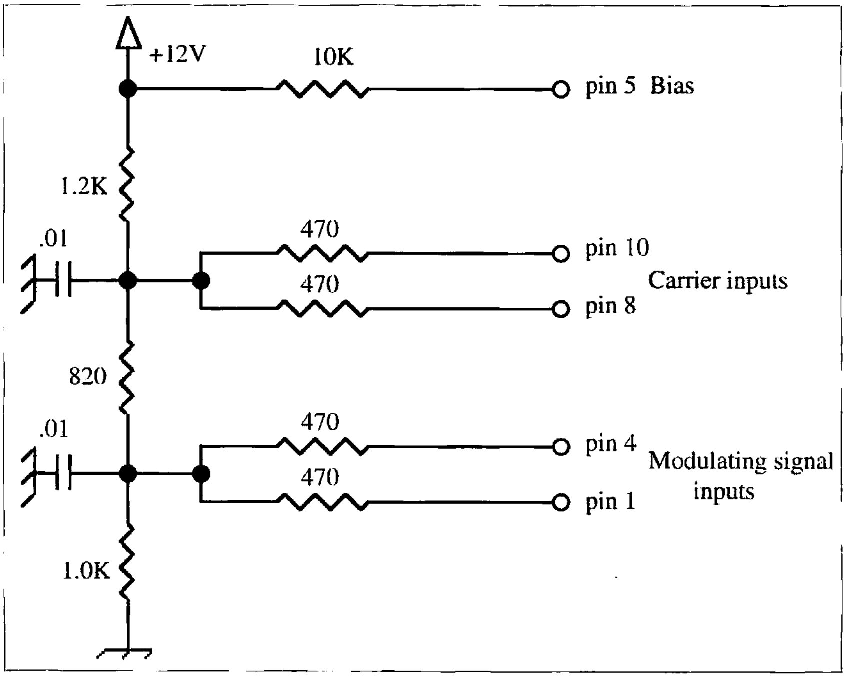


Fig. 4. Bias circuit for 12-volt operation.

If all is well so far, you have verified that the mixer is truly a double balanced one.

Now what about the sum and difference frequencies? Apply both the carrier and the modulating signals. You should see an output again with a level two to three times the level of the weaker of the two inputs, provided the stronger one is greater than 100 mV rms. But is this the sum or the difference?

Well, at this point it's both. One way to check is to use a tunable filter ahead of your RF voltmeter (**Fig. 5**). By tuning the filter first to the difference frequency (4 MHz) you can check its presence on the voltmeter. Then by tuning the filter up to the sum frequency (14 MHz) you can check for that, too. As the filter is tuned from 4 to 14 MHz, the level on the voltmeter should be at least 40 dB lower. This includes the fundamentals at 5 and 9 MHz, as well as harmonics (for example, at 10 and 15 MHz). Higher order mixing products such as (3 x 5) - (1 x 9) = 6 MHz should also be of low amplitude.

"You can check for a signal at the output with a sensitive wideband RF voltmeter."

Every mixer circuit should include or be followed by a filter circuit to select either the sum or difference output and reject the other. Typical amateur-quality filters will also provide at least 40 dB rejection of the unwanted mixer output frequency. You can also check this with your voltmeter and tunable filter.

Building a simple tunable filter

A basic tunable filter can be constructed using a single tuned circuit. It can consist of a high-Q toroid coil and an air-dielectric variable capacitor (**Fig. 6**). After winding the toroid core with the main tank coil, two link coils of two to five turns each are added to serve as input and output ports.

Almost any frequency range can be covered by selecting an appropriate core and number of winding turns. As a

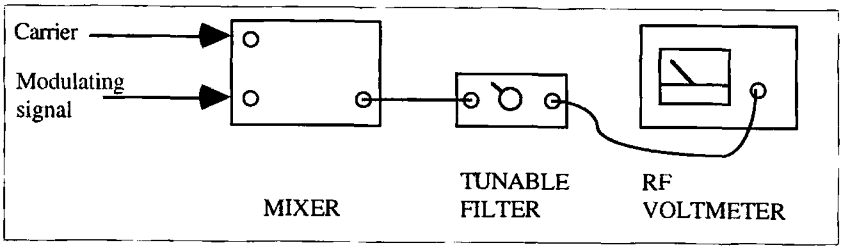


Fig. 5. Using a tunable filter ahead of an RF voltmeter.

convenience, an optional DPDT slide switch can be added to bypass the filter. Mount the whole thing in a small (3" x 2" x 1.5") aluminum box, using BNC connectors for input and output.

Calibration

You can mark frequency calibrations on the tunable filter dial by using a calibrated signal generator. Feed a known frequency into the filter and connect its output to the RF voltmeter. Tune the filter for maximum output and mark the frequency on the dial. Continue with other known frequency signals until the entire range has been calibrated. A dipper with a two-turn coupling link wound over its coil and connected to the input BNC jack can substitute for the signal generator if necessary.

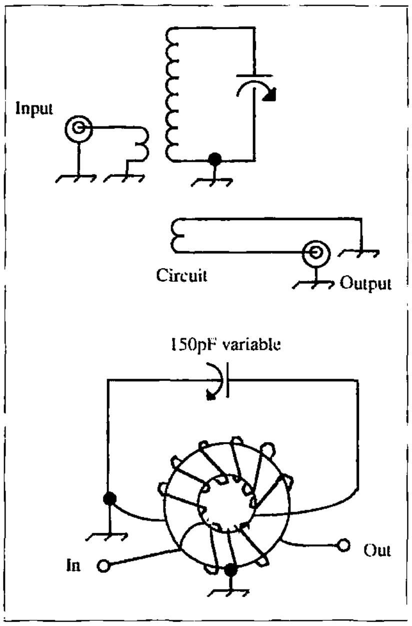


Fig. 6. Basic tunable filter circuit. For 7-20 MHz, use 38 turns #26 wire on T68-10 core. Links, 5 turns #26. For 22-60 MHz, use 10 turns #20 wire on T68-10 core. Links, 2 turns #22.

Other circuits

In addition to the MC1496, other double balanced mixers are the TL442CN, formerly known as SN76514, and the NE602. Single balanced and unbalanced mixers are also widely used—the only difference is whether or not the carrier or modulating signal is rejected at all by the mixer circuit itself. In a single balanced mixer such as the CA3028, one will be rejected.

With an unbalanced mixer such as the dual-gate 40673, neither input is rejected.

Both will appear at full strength at the output along with the sum and difference signals.

It's up to the filter following the mixer to reject all but the desired sum or difference frequency. As a minimum, at least 40 dB of rejection should be used.

Signal levels at the inputs and output should be checked to ensure that *only* the desired mixing product is passed on to the following stages in a ham transmitter or receiver.

A sensitive wideband RF voltmeter and outboard tunable filter are essential to perform the checks, but can be easily constructed at low cost. With these on hand a ham can verify or troubleshoot his mixer circuits with confidence.

References

1. "dBm Meter," John Pivnichny N2DCH, *Electronics Now*, Nov. 1995. A complete kit including case is available from Unicorn Electronics, Valley Plaza Drive, Johnson City NY 13790, (607) 798-0260.

2. "A Sensitive RF Voltmeter," John Pivnichny N2DCH, *Ham Radio*, July 1989.

3. "An RF Voltmeter," Ian Braithwaite G4COL, *Ham Radio*, Nov. 1987.

Build a Half-Square DX Antenna

It's about as simple as they come. And it sure works!

William Van Tilburg KG8AN
5198 West Valley Circle
Portage MI 49002-1932

The half-square antenna is a gain antenna, yet it is one of the easiest, quickest types of antennas to build. This half-square configuration is a DX antenna that on 10m starts picking up signals from about 500 hundred miles out and gets stronger as the signals come from farther away.

The physical size is a full wavelength long, divided into three sections. You have a half-wave section on top, with a quarter wavelength dropped straight down on each end. To figure the length of an antenna you work a simple math problem. The formula is 1,005 divided by the frequency in MHz. This results in an answer for a full wavelength in feet.

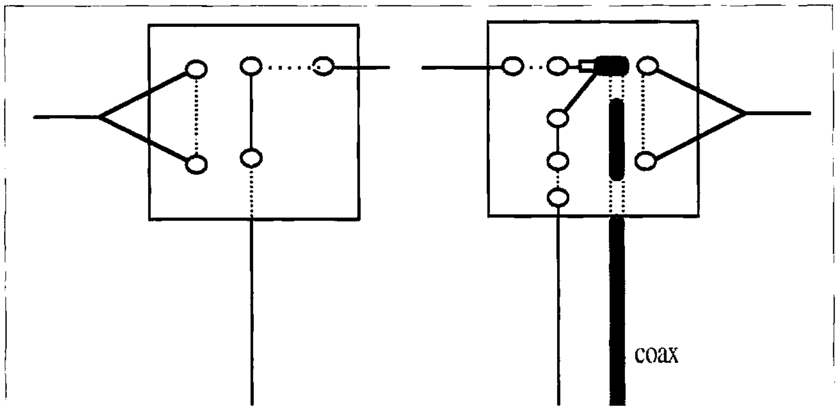


Fig. 2. Feeding the cable and wire through the pre-drilled holes will lock it in place with nothing but the force of friction.

Let's try a sample

First, let's go for the 10m phone section. The middle of the band I want will be 28.4 MHz, where the Novices/Techs can operate. That's 1,005 ÷ 28.4 = 35.387 feet of wire to start our antenna. That's 35' 4.5". You will need an extra three inches to allow for a small tie loop at the bottom end of the quarter-wave down legs. Each active quarter-wavelength is going to be 8.846 feet long (8' 10") so double the wire back to find the center and mark it with a piece of electrical tape. Next, you need to measure 8.846 feet out from our tape marker toward the ends. The down legs will also measure 8.846 feet, plus the one and a half inches for the tie loop.

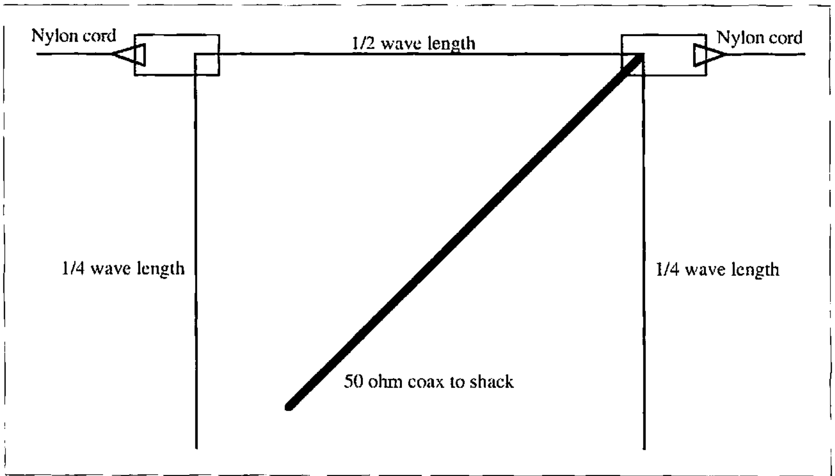


Fig. 1. The whole half-square antenna complete with insulators made from broken lawn chairs.

I have found that a broken white plastic lawn chair can be cut up to make very good antenna insulators. Cut rectangles 1.5 inches by 2.5 inches and drill holes as shown in Figs. 1 and 2. I use a covered wire about #16 gauge, which helps keep down snow static. String the half-wave section in one hole, over and through the second hole, and down through the third hole towards the ground. On the other end, cut the wire at the corner of the top and down leg. Feed the wire across two holes to lock it in place. The other quarter-wave wire is fed up from the vertical through the holes in the plastic to lock it in place as seen in the diagram.

Next, we need to feed the RG-58

through two holes to lock it in place; secure the center connector to the top horizontal section and then connect the braid or shield to the down leg as seen in **Fig. 2**. Next, string the nylon antenna support cord through the end holes to support it between trees, towers, or buildings. The connections of all wires need to be soldered and then taped for weatherproofing.

You need to keep the coax end of your antenna toward the transmitter and at right angles if possible from the top wire. Now pull your antenna up as high off the ground as you can get it.

The height of your antenna off the ground will affect its tuning. Remember, the higher the frequency, the shorter the wire will be. Shorten the wire top section and the legs to make the resonant frequency of the antenna higher. Make your adjustments about 1/2 to 3/4 inches at a time. If you change one leg by 1/2 inch, the top section will have to change by one inch. Make any required adjustments to find the center frequency and it's ready to transmit. Tie a loosely dangling retainer cord to each of the down leg loops to keep it from blowing over the top wire.

The maximum radiation is broadside, so an antenna strung north and south will do best to the east and west. I use this type of antenna at home on 10m, and also during Field Day on 20 from Kalamazoo County, Michigan.

Some of the half-square advantages are about 4 dB gain, a low radiation angle, good noise-canceling characteristics, both vertical and horizontal polarization, and low cost.

I've talked all over the world with this antenna, so be sure to let me (and Wayne) know how it does for you!

Editor's note: You can greatly simplify the trimming of the antenna if you cut it a little long to start, then find where it resonates (minimum SWR). Now you can make a simple ratio of the antenna length divided by the resonant frequency equaling the desired length divided by the desired frequency. This way, it takes just one trim session and you're in business without all that half inch at a time from each part of the antenna. For example, if you come out 8" too long, just cut 2" from each quarter-wave section—4" from the horizontal section and 2" from each vertical leg.

NEVER SAY DIE

Continued from page 39

Describe his offense briefly, and if you have a tape recording so I can join you in your condemnation, that won't hurt.

Perhaps the potential for public exposure and humiliation will help make our hobby more fun for us.

But, while we've an interest in cleaning up our bands by exposing the bad apples, we also should have a medium for rewarding the hams who are helping to make the hobby better. So I'll get busy on both Good Apple and Bad Apple Nomination Certificates. If you know any hams who have contributed positively to the hobby, please don't wait until they're silent keys to nominate them for the Good Apple Certificate.

If you are an artist or cartoonist (or know one), how about a couple of illustrations for the certificates? I need a really disgustingly bad apple drawing, and a good apple.

Now let's see what we can do to reward the good guys and humiliate the bad guys. And if you run into K3ZO on the air, please tell him "Turnips from Wayne."

The Code Again

A note from reader Boucton in France mentioned that France has decided to end all CW maritime transmissions as being obsolete. It is expected that the other European countries will follow suit. That pretty much leaves the use of Morse to a small group of aging amateurs. How quaint.

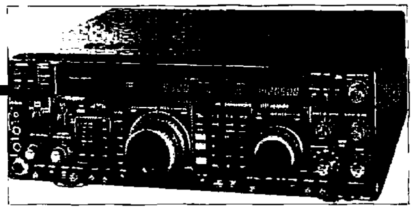
In a similar vein there was a mention in *The Old Timer's Bulletin* that radio pioneer Lee DeForest had always had an interest in amateur radio, but could never build up his code speed enough to get a license.

Continued on page 55

73 Review

The Yaesu FT-1000MP Transceiver

Check out the "Big Rigs."



Richard Lubash N1VXW
E-mail: rlubash@poco.mv.com

This transceiver was introduced by Yaesu to commemorate the father of SSB communications, Yaesu founder JA1MP. The 1000MP combines some of the best of traditional radio construction (Collins filters) with high-end, high-tech, state-of-the-art design.

When I got the radio home I really wanted to try it out—I didn't want to spend time going through the 104-page user manual. Though I have since become good friends with the manual (a very well written and useful tool), I was able to get the 1000 on the air with minimal referral to it. The first thing you notice when you turn on the receiver is the sound. It's a big sound, quiet and full; not that traditional midrangy basic communications-type sound. After spending some time tuning around and enjoying the reception in both the CW and phone sections of the amateur bands, I took it for a cruise into the general coverage waters. If you're a ham who enjoys occasional SWL, here's a treat for you. The manual even turns you on to how to listen to a general coverage station with the main receiver tuned to one sideband and the sub-receiver tuned to the opposite sideband—with the combined output into a stereo set of phones... whew!

Receiver

The Yaesu 1000MP offers dual VFO reception with separate tuning and display for main and sub-receivers. Both receivers use quad conversion superheterodyne circuitry with three IF stages at 70.455 MHz, 8.215 MHz and 455 kHz in the main receiver and two at 47.21 MHz and 455 kHz in the sub-receiver. The tuning is accomplished through the use of Direct Digital Synthesizers driven by a TCXO master oscillator, resulting in extremely fine tuning with thirteen selectable tuning steps down to .625 Hz. Receive range is from 100 kHz to 30 MHz, with front panel selection of USB, LSB, CW, AM, FM, RTTY, and PKT.

Frequency selection on both receivers is available by direct tuning; a shuttle jog ring that allows large or small frequency change without cranking; individual amateur band keys with dual access to two user-defined sections and modes of each band from 160 to 10 meters; direct keypad input and memory selection from 99 regular memories; nine program limit memories or five quick memories. Memory can be configured in an almost unlimited variety of scanning options, and both VFOs can be modified in receive and transmit with a clarifier offset.

The QRM-fighting arsenal of the 1000MP includes individually selected cascaded second and third IF crystal filter banks, with 2400 Hz and 500 Hz filters installed and room for additional filters at 2 kHz and 250 Hz; an IF notch filter; IF shift and width controls and EDSP. EDSP stands for Yaesu's Enhanced Digital Signal Processing. This system works at the IF stage of the receiver and provides settings for random-noise reduction, selectable bandpass filtering with adjustable low and high cutoff skirts and automatic heterodyne notch filtering.

Transmitter

The transmitter in the 1000MP is capable of output on all amateur bands from 160 to 10 meters. The output power is adjustable to 100 watts in all modes except AM where output carrier power is 25 watts max. Output modulation include SSB, AM, FM and AFSK. The transceiver includes a high speed antenna tuner with 39 memories, and a full-function electronic keyer with multiple emulation types for the CW enthusiast. The EDSP used in the receiver is also capable of transmit audio enhancement utilizing four different voice equalization schemes.

Display

Yaesu engineers have left nothing to chance in terms of visual indicators for operating parameters. The 1000MP display has a fluorescent, multi-color, easy-to-read digital control panel. The tuning frequencies of both receivers are shown in large orange numerals. In addition, there is an expanded tuning scale that works as either an Rx, Tx clarifier tuning scale, or a tuning indicator for increments of less than 10 Hz. Separate S-meters for each receiver are bargraph digital type with the main receiver meter also incorporating RF power output, final amplifier collector current, SWR, speech compression, ALC, and DC supply voltage or microphone audio input level. If that's not enough metering, there is also a tuning scale that provides a center tuning segment for zero-beating CW stations and twin bars for mark and space tone tuning of digital modes.

Want more display? There are multi-color indicators for everything from HI SWR to external computer control. The Multi-Display window allows for a choice of memory channel frequencies, split offset or CW pitch. As a final touch, the sub-receiver, not having lighted mode selection buttons, provides visual indicators under the frequency display.

Front panel controls

The manual suggests that you familiarize yourself with the front panel controls and then goes on with seven pages

of short descriptions. This rig has all the knobs and buttons you will need to keep your twisting urges satisfied. Although the number of controls is daunting, the layout is logical and the silk-screened labels very readable (white against black). The left side of the rig has provisions for both .25-inch and 3.5-mm stereo headphones, a three-contact paddle/keyer input and a microphone. Concentric AF gain controls let you adjust audio output from both receivers and allow mixing into stereo phones in the dual reception mode. You can monitor your transmit RF audio, switch antennas adjust sidetone CW pitch and RF power from the front as well as all the standards: SQL, meter select, stepped AGC speed, mike gain, proc and a host of others too long to mention.

The receiver bandwidth module is controlled from its own silk-screened section of the front panel. Second- and third-stage IF filters, both factory installed and optional, can be configured for a wide variety of operating conditions. Both the 455 Hz and 8215 Hz IF stages have filtering selectable at (2nd stage) 2.4 kHz, 2 kHz, 500 Hz and 250 Hz; (3rd stage) 6 kHz, 2.4 kHz, 2 kHz, 500 Hz and 250 Hz.

The control cluster around the main and sub-tuning knobs allows for frequency and operational mode adjustment. The band keypad provides for direct frequency entry, or switching to any of the available amateur bands for the main and sub-receivers. The amateur band switching mode lets you select either of two VFO settings per band, allowing you to push once for settings in the phone section of the band and a second time for the CW or digital portions. Memory input and selection, quick memory, split and dual-channel reception are also controlled from here.

To the right of the front panel you'll find the controls for the EDSP, clarifier, notch, shift and width, noise blanker, antenna tuner and electronic keyer. I haven't included every control because as I mentioned the brief description section in the manual is seven pages long.

What's around back

As we all know, no matter what you see in the way of enhancements up front there should be an easy way to interface your transceiver to the rest of the shack. The 1000MP covers this need with a well-laid-out back porch. We start the tour with twin PL-259 selectable antenna jacks. These connectors are always used to feed the antenna for transmit, with or without the antenna tuner, and may be selected for receive function as well. If a separate receive antenna is used, it can be plugged into an RCA-type jack that is selectable from the front. Additional input/output provisions include: CW phone jack; RS-232 for computer interface; digital voice recorder in/out; packet; RTTY; linear ALC; audio in (AFSK or voice); external speaker; low level AF out for recording or amplifier input; ground; band data for external linear or tuner; +13.5 VDC out; transverter drive output; linear Tx/Rx switching and ground; 13.5 VDC input for external DC supply, and AC line in.

In the way of back panel controls the only two are a backup slide switch that enables power-off memory for the memory and VFO settings and a CW sidetone volume adjustment trimmer that I would have preferred as a front panel knob. Additional adjustments (11) are found by way of a top panel access hatch.

User configuration

One thing that stands out about the 1000MP is its ability to customize the transmitter and receiver parameters to almost any imaginable user preference. The rig comes with over 80 selectable menu options that are divided up into eight subsets. These sets allow for configuration of memory groups, shuttle jog ring tuning speed, IF shift width step, display frequency resolution, transmit audio tailoring, digital mode parameters, and electronic keyer configuration, to mention just a few. The concept here is "have it your way" and Yaesu has gone out of their way to make it so. As icing on the cake, the user button allows you to preconfigure a whole set of operating parameters so that you can switch to a mode such as RTTY or SSTV—with the touch of a button, all parameters for the mode are set.

Operation

The first time I had an opportunity to really get into the operation of the rig was, as luck would have it, a contest weekend. Although that did not allow for any leisurely DXing, it did give me a great opportunity to check out all the receive features that are so appealingly described in the manual. I found that the receiver, although offering a multiplicity of options for configuration, was very user-friendly and, with not much practice, I was able to sort the weaker contest stations from the general chaos found on 20 meters. The 2.4 kHz IF filters worked great, giving a nice clean SSB sound, though if you are thinking of using the rig for serious contesting the optional 2 kHz filter would be a plus.

I took the rig down to forty meters to give it a real interference workout and after first configuring the programmable menu for selectable auto or manual notch filter, I found some real nice heterodynes working on a station and kicked in the auto notch function on the EDSP. It performed like magic by wiping out the offending heterodynes with the push of a button. While I was down on 40 meters I thought I'd give CW a try. I switched to a dipole from the multiband vertical and gave a short CQ. I got a come back from KE4LRH in Richmond and had no problem cutting through the 40-meter QRM using a combination of the 500-Hz filter and the EDSP noise reduction. The electronic keyer was easy to use and had the nice feature of having the sidetone adjustment (pitch, as well as speed of code) on the front; a number of other keyer features are available through menu configuration. The QSK mode worked great and switching between transmit and receive was silent and instantaneous. I worked some more on 40 and then went down to 80 meters. The noise reduction and big quiet sound made copying a pleasure, even on the crash band. The transmit audio was judged very nice by a number of hams I talked to—all in all, the rig performed like a thoroughbred.

I used three different antennas, and the tuner met the challenge without a whimper even on a damaged G5RV. The basic feel of the tuning knobs and controls is one of quality, and the layout, though complicated, is logical and has what I would consider a relatively easy learning curve for such a complex piece of engineering. The 1000MP is a rig that would do the serious contester or DX chaser proud—but isn't too complicated for the ordinary ham who's into multimode communications and wants to step up to a big rig.

73 Review

Thanks for the Memories!

The WB9KZY Island Keyer from Jackson Harbor Press.

Marshall G. Emm AAØXI/VK5FN
2460 S. Moline Way
Aurora CO 80014
75230.1405@compuserve.com

Designer Chuck Olson (the eponymous WB9KZY) was tempted to call this the "YAK," for "Yet Another Keyer." Fortunately he reconsidered, because the "Island" is a lot more than just another keyer.

Take a look at what memory keyers and kits cost in the marketplace. Here's a complete board kit for $21.95 that has four separate memories for a total of 500 characters, it's physically tiny (1.5" x 2"), and it can be configured to use less power than your average LED. It has straight-key input, a sidetone oscillator with selectable audio pitch, speeds from 7-48 wpm (set with a pot), and it will even tell you (in Morse) what speed is currently set.

This is a keyer that is physically small enough (and has low enough current drain) that you can mount it inside the smallest of QRP transceivers. Actual power requirements will depend on a number of options, but if you leave out the memory and the voltage regulator, it will idle at less than a microamp. On the other hand, it is so versatile that you may also wish to consider mounting one in its own enclosure as your "main" keyer. Several options are described in the documentation, and you are bound to think of more as you put it together.

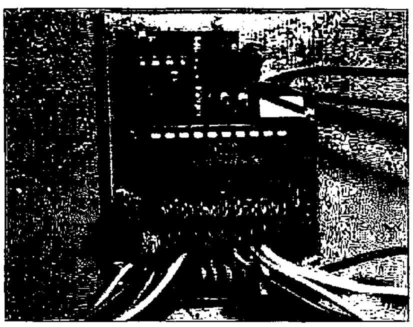


Photo A. Top view of PCB.

There are some features "missing," of course, but in many respects, especially the memories, it is way ahead of the Curtis 8044 series keyers, and costs less than most of the non-memory keyer kits! In his documentation, Chuck acknowledges a few shortcomings. Here they are—decide for yourself how important they are. The Island Keyer doesn't do contest serial numbering; weighting is fixed; it doesn't do automatic spacing, and it can be difficult to load the memories since there is no facility for editing them. Wait a... there *is* a facility for editing the memories. Just ask, and Chuck will send you a QBasic© program and instructions for using your PC to load the keyer!

OK, what about the other "shortcomings"?

Weighting is fixed? I see that as a plus. Standard ITU Morse 1:3 weighting is fine for 99% of us who routinely operate slower than 30 wpm, and generally acceptable up to the keyer's maximum speed. Besides which, variable weighting is not all it's cracked up to be—I had no end of difficulty in setting 1:3 weighting on another keyer kit I built. I've heard of people overweighting so that their keyer will sound like a "bug," but in fact what they are emulating is not good Morse—a properly adjusted bug driven by a competent operator should sound just like a keyer!

No automatic spacing? Who needs it? Again, if you change operating speed you have to change your keying methods anyhow, so why worry about the lack of a feature which just encourages sloppiness? And serial numbers are becoming less important as a keyer feature, because most serious contesters are already using keyboards anyhow, and many contests have dropped serial numbering from the exchange. No, I don't think there is anything of any consequence missing from this keyer.

Construction

When you set out to build the Island Keyer, you need to do a bit of planning, because there are so many directions you can take.

First, decide how you intend to mount it (you may need to drill mounting holes in the PCB, and that's a lot easier *before* you solder components onto it).

Then think about power—it's designed for 3-5V operation, and includes a 78L05 regulator. If you leave the regulator out you can power it with a couple of AAA batteries. If you power it with a 9V battery (or a 12V supply) you will need the regulator, but keep in mind that it will draw perhaps a milliamp itself. If you want, you can install a socket for the regulator, so you can pull it (and perhaps also the memory IC) for battery operation. Mine's set up as a stand-alone keyer, so I didn't worry about current consumption and in fact added a power-on LED.

Decide whether you will want to connect a speaker to the audio output. The output is adequate to drive a small speaker, and it is great to be able to check memory contents, speed, or even just to practice without keying a rig. As suggested in the manual, you may also want to add an SPST switch in the output (keyed) line to segregate the keyer from the rig. I included the speaker, and a volume control pot—in fact, I used a Radio Shack™ combination pot and switch, so that the one control would turn it on and set the volume.

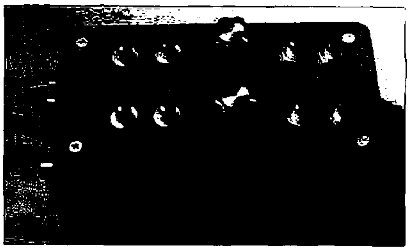


Photo B. Complete!

You should also decide whether you will want to connect a straight key, and if so whether you want the straight key to trigger the keyer or just go across the key line. The documented approach makes sense, so you can use the keyer as a code practice oscillator.

The rig requires 7 push-buttons. Radio Shack sells momentary buttons in sets of four, with two red and two black in each package. The color coding is handy, since there are four memory/send buttons and three function buttons. But what to do with the extra button? I simply put it across the key line as a "tune" switch.

Finally, if you ask for them, Chuck will provide instructions for adding in a simple delay timer based on a 555 timer chip. It requires one more pot and a couple of resistors and caps, but it is an easy way to set up the keyer as a beacon, or for repetitive CQ calling with a variable delay.

I'd suggest that you install wires for each of the off-board connections, even if you don't intend to use them. If you decide to add something later, it will be a lot easier to connect it to the existing wire than to try to connect a new wire to the board after it has been installed in a rig or box.

Building instructions are included with the kit, and if you have modest skills you will have no trouble in completing the project in about an hour. There is some tricky soldering involved, due to component spacing, so you will need to use a low-wattage iron with a fine tip, and work under a magnifier (or at least check each joint with a magnifier). Take your time, and watch for solder spatters and drips.

The two ICs (CPU and memory) are static-sensitive devices, so exercise the usual care in their handling—keep handling to a minimum, and make sure you are grounded: for example, with a clip lead between your wristwatch and a convenient grounding point.

I installed the completed keyer in a small plastic box with holes for the speaker in the bottom; the eight buttons and two pots on the top; and jacks for paddle, straight key, and output, along with an output toggle switch, on one end. You may want to use a metal box if you will be using a lot of RF power—the microprocessor may be susceptible to interference, but no problems were found in my QRP operating environment. The power cord exits from that end of the box and terminates in a Molex™ connector. Here's a handy hint for you: Calculate what size box you need, then get one that is half-again as big! No matter how carefully I measure and plan, I always seem to end up having to sit on the box to get the lid closed.

The smoke test

As you might expect with a kit having so few parts, there's not much that can go wrong if you did a good job of soldering. Once you've connected power (and assuming you've connected a speaker), just press the speed button—the keyer should send Morse numbers reflecting the currently set speed in wpm. Then connect a rig to the output and see if the keyer does, in fact, key. If connecting a rig is not convenient, just connect a multimeter across the output, set the keyer for its slowest speed, and observe a change in resistance as the circuit is keyed. Finally, check memory operation by loading a character or two into each memory, in accordance with the instructions.

If the keyer fails any of the above tests, take another look at component placement and examine the solder joints. And if you *still* have trouble, get in touch with Chuck at Jackson Harbor Press.

Operation

This is a nice keyer to use. It keys precisely, and doesn't seem to have much "feel." By feel, I mean operating characteristics that take some getting used to, so lack of feel is a good thing. But the ability to practice keying without connecting a rig is a real plus. Another feature is that if you connected a straight key jack to the straight key input (rather than across the output) you can use the keyer as a code practice oscillator and sharpen up your hand-pump skills.

The controls are simple—separate pots for sidetone volume and speed, and seven or eight buttons. Four buttons are devoted to the memories; one reports speed; one stops memory sending; and one triggers memory loading. As stated, on my version an eighth button goes across the key line as a "tune" button, and the volume control also serves as an on/off switch.

To load a memory, you simply press the load button followed by the button corresponding to the memory (1-4) you want to load. The keyer will respond with "?" from the speaker, and then it's just a matter of keying in the text you want to store. Automatic character and word spacing are enabled during memory load, so you can take your time. Press the load button again when you are finished, then the memory button to play back the recorded message. The total unused memory capacity can be considered as "available" to any unused memories, so, for example, memory one can contain up to 500 characters. Memory two can use all but the first 120 characters, and so on.

The Island Keyer is a lot of fun to build and a lot of fun to use, representing outstanding value for the money. In doing this review I spoke to Chuck personally, and found him very helpful as well as very interested in suggestions from users for a possible "upgrade version." One of the great benefits of programmed keyers, as compared with, say, the 8044, is that an upgrade will be just a matter of popping in a new chip.

Availability

The WB9KZY Island Keyer kit, consisting of circuit board and all board-mounted components, is available at a cost of $21.95 (+$2.00 shipping/handling) from: Jackson Harbor Press, RR1, Box 91C, Washington Island WI 54246. Phone (414) 847-2761; E-mail: [chuckolson@juno.com]. Credit card orders (only): (800) 238-8205.

Author's note: After reviewing this keyer, I found myself so impressed and pleased with it that it's also now available from my own company, Milestone Technologies. We also have available a "hardware pack" containing the necessary pots, knobs, switches, jacks, and a speaker. Our Web site is [http://www.mtechnologies.com/mthome].

On the Go

Mobile, Portable and Emergency Operations

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

A few years ago, a friend of mine said to me, "Disaster communications isn't one of the reasons for the amateur radio service—it's the *only* reason! The radio frequency spectrum is too valuable to give to anyone just for hobby use, especially the number and different types of bands available to ham operators. The government lets us have these for support in disasters; if there's no disaster, go ahead and have fun!"

He was definitely right about the value of the radio spectrum. As we've seen recently, not only is there more demand for access to it, but also the government has found that frequencies can be sold for substantial amounts of money. We are privileged to have access to choice portions of so many bands. While DX, rag-chewing and contesting are fun, they do not justify the investment the government has in amateur radio frequencies. Amateur communications in support of disaster relief is one of the best ways we have to provide enough value to society to allow us to have one of the best playgrounds in this universe.

Naturally, there are other services which are positioned to provide similar support, and they will use such claims to justify expanding. Most public service agencies, such as police and fire departments, now have multiple radio systems. Cellular telephones are almost as common as cassette tape players in cars. These are often viewed as having eliminated the need for our traditional role. Fortunately, amateur radio does provide a number of advantages over other services, and acts as a significant augmentation to the communications services used in daily public service operations.

Portability

The days when an amateur station was a large tube-driven stationary system are long gone. Hand-held and mobile units predominate in the VHF and UHF frequencies, and there are so many 2-meter and 440-MHz repeaters that the frequencies have to be coordinated. Most modern HF rigs can be carried in one hand and powered from an automobile battery/alternator as well as from a 110-volt to 13.8-volt power supply. An amateur station can be quickly set up in a location which has inadequate or non-operational communications. This means that a shelter set up in a school gym can be quickly plugged into the emergency network.

"Cellular telephone systems can get overloaded in normal usage; in emergencies they jam up."

Multiple simultaneous contacts

While cellular phones have grown in popularity, they do not lend themselves to disseminating certain types of information. Since each intended recipient must be individually contacted, multiple calls must be made for each message. With amateur radio, all stations on a given frequency can be simultaneously made aware of the same information. Frequencies can be assigned to allow one network to provide general communications, another for command functions, etc.

Training

It seems that almost everyone these days is as comfortable with the Internet and World Wide Web as they are with the telephone. However, not everyone is as comfortable with taking detailed messages as hams are. More importantly, a well-run, properly disciplined network will less likely be jammed by would-be users. Cellular systems, on the other hand, can be overloaded during normal operations in some areas, and have significantly higher usage during emergency situations.

Coverage

Although not every repeater has long-term battery or emergency power, usually there are adequate reserves to allow for initial operation. After these reserves are exhausted, it is possible to set up portable repeaters or arrange for auxiliary power for the repeater. For wider area coverage, the high frequency bands can be used to permit longer distance communications. And, when all else fails, it is possible to utilize the old-fashioned method of relaying messages.

Cross-coverage

Because of the portability of amateur radio, and the range of frequencies available, hams can act as a bridge between various agencies. In many cases, police department radios may not be able to communicate with the fire department, or neighboring police departments; the Red Cross frequencies are different from both; and the National Guard uses military frequencies which are different still. Amateur radio operators can be stationed with the communications people of other services and pass traffic from one service to another. Likewise, it's not unheard of for a ham stationed at a police or fire dispatching post to spend 90% of his or her time backing up the dispatchers on their equipment and 10% on the ham bands.

The price is right

The government agencies which the amateur service supports receive this support at no cost. As amateurs, not only are we expected to provide emergency communications, but also we are prohibited from being paid. In addition, we show up with our own equipment! It would be tough to find a better deal.

Enthusiasm

Let's face it, in an emergency situation requiring the support of ham operators, we tend to show up charged with a healthy dose of adrenaline. Amateur radio is one of those special hobbies which gives us the chance to make an important contribution to our community. In doing so, we are using many of the same communications tools and techniques that we count as fun on other days. In my experience, when the call goes out, the response is overwhelmingly positive.

Diverse talent pool

Hams represent a fairly broad spectrum of talents. Sometimes these other talents allow assignment of people to locations where they can really hit the ground running. Hams with health care backgrounds, for example, can be assigned to hospitals; those with a military background are a more natural fit for the National Guard. It is amazing what some hams are capable of doing. During the aftermath of a tornado a few years ago, I was impressed by the extreme smoothness of the net control operator. He kept track of everybody's name, callsign and location, better than I could have with a computer. Later I found out he was blind, was used to keeping all these facts as mental notes, and had no need to refer to anything to refresh his memory.

There are lots of possibilities for the amateur community to provide key service in an emergency situation. However, this is not an automatic guarantee that hams will be ready, willing

and able to follow through. There is also no guarantee that our services will be welcome. If you were a mayor or a city manager facing a crisis, would you realize that amateurs were a resource at your disposal? How would you let them know they were needed and coordinate their activities? A lot of work needs to be done before the need arises, but fortunately most of the work is fun, interesting, and more satisfying than exchanging RST, rig and antenna information.

This column will explore a number of different aspects of emergency communications. Since there are many excellent organizations throughout the country, I'll try to get different viewpoints on what works well. We'll explore network operations, different types of equipment, setting up portable stations, coordinating amateur activities with local government operations. Likewise, we'll look at the types of emergency service support required in different situations. What's needed for SkyWarn weather spotting is different from what is needed following an earthquake. Winter storm situations place a different demand on operators than a hazardous spill situation. We'll also look at managing an operation—while the response in the early stages of an emergency is strong, how can we maintain that response days or even weeks later?

"Amateur radio gives us a chance to make an important contribution to our community."

I hope you'll find this column fun and interesting. If you've got ideas, please feel free to send them either by E-mail to 74640.1442@compuserve.com or by snailmail to the address at the top of this column.

NEVER SAY DIE

Continued from page 49

Our Story

Time was when I'd get several ham-promoting newspaper clippings a week from readers. Now, it's rare. Sure, I've tried to sell the idea that every ham club should have a PR officer whose mission is to make sure that meeting notices are published in the local newspapers and provided to local radio stations, but even more important, to make sure that any club or member activity that provides a possible excuse for newspaper, radio or TV coverage is exploited. Field Day? Get a story and photos to the newspapers before and after the event. Any emergency services ditto. If there's a local school radio club get the story into the papers. If someone in the club makes DXCC or wins a contest, get photos and a story to the papers. We need visibility and we need it desperately.

My thanks to Ed Lappi AE4EC for sending a copy of the Chapel Hill *Herald*, where there was a full page story of the local school radio club. But I should be getting clippings like that every day, not once every few weeks. Get on the stick, clubs.

Talk Radio

Back in the '50s Jean Shepherd K2ORS got started in radio broadcasting in Cincinnati, as I recall. Soon he had a nightly show on WOR, clear channel 710. He was on from around 11 pm until 5 am nightly. This was not talk radio as we know it today. Jean just sat there and talked for six hours a night, with no call-ins to take up the slack and no guests to interview. And Jean built up one heck of a following. Then he got into writing, with a bunch of prize-winning stories published in *Playboy*, a series of great books, and eventually he wrote a string of wonderful movies.

He was followed on WOR by Long John Nebel, who brought in guests to interview and built a huge audience by getting into the weird stuff. These days he'd have contactees and such.

And that's pretty much the Art Bell W6OBB formula. He's on nightly from 11 pm to 4 am PST on over 300 radio stations. Some only carry his program for three hours. The only station I can hear well is WTAM in Cleveland on 1100 kHz, and they only carry three hours. Art interviews some very interesting people, plus he also lets the audience call in to ask questions and make comments. He gets into very weird stuff at times.

I keep a little radio beside my bed and, if I happen to wake up during the 2-5 am slot, I check to see who he's got on. Just in case he has something I wouldn't want to miss, I set my video recorder with the radio input to the audio jack, and record the three hours every night. Well, it's something to listen to while I'm opening my mail, and these days that often takes an hour or two.

Check the broadcast band some morning and find out which station brings in Art's show best for you. And every now and then you'll hear *me* being interviewed.

My interviews on his show have resulted in letters from listeners in all 50 states, Puerto Rico, the Virgin Islands, and even Israel and UK. The last two are from an Internet "broadcast" of the show.

I've got so many things to talk about that sometimes I think about having my own show. But something like that ties you down, and I still have a bunch of countries I want to visit that I haven't seen yet. So I'll have to make do guesting on talk shows. But if I were to do my own show it would be different from any other I've heard. My aim would be to get people excited about improving their lives. About getting healthy. About making money. About self-education. About making our lives better through a much smaller government. Through re-inventing our school system. About eliminating poverty and the drug problem. Making prisons less of a growth industry. Well, you know, all those things I've been writing about.

But, would it sell? Probably not. Heck, I haven't been able to get *you* interested in living longer or getting healthy, so perhaps I'm just spinning my wheels.

Sure, you want me to write about amateur radio. Fine. But when I ask you to write and tell me about the most exciting times you've had with the hobby I get *bupkis*. Ham radio has provided

Continued on page 77

THE DIGITAL PORT

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703

How to get the most out of your local PBBS

Would you like to get better acquainted with the strictly-for-hams bulletin boards and stay posted on such hot items as DX propagation, AMSAT information, the latest from the FCC or what your local club is up to? You can also hunt for bargains for your ham shack or clear out some of your own clutter for cash—there is a continuous swap meet in progress and you can visit it from the comfort of your shack. Plus, there are no membership costs, and it is available 24 hours a day.

You will be well rewarded for the time you spend getting to know the ins and outs of your local ham packet bulletin board system (PBBS). If you have been letting this exciting technology pass you by because you just didn't want to learn another new thing (and it looked expensive), getting started is easy—and can be accomplished on a budget. And you'll have fun learning something new, and that is what a lot of ham radio is about.

Learning experience

I strayed from the norm a little and was exploring the node portion of the local system. In the *Just Heard* category, there were about a dozen callsigns, and one of them had a "-1" extender on it. I thought it would be fun to leave this ham a message in his mailbox—hardly anybody gets personal mail that way.

I was connected to the node okay, but my attempts to connect to the ham station were continually rebuffed. The command [c kb7xxx] just wasn't recognized. As they say, when all else fails... I remembered, once again, why I go to the effort to download the user manual from the local node/bulletin boards when I first get acquainted with a new one. The user manual spells out the steps to take. It is necessary to designate the port number on this system to make the connection and *presto*! There I was in his mailbox. A few days later, I received a nice note on the PBBS after he found the message. I look in on the PBBS frequently as it is a good source of recent happenings both locally and across the country.

So how do we overcome these little frustrations? Unless you have psychic gifts and can read the mind of the person who wrote the software, the easiest method I have found is to read the manual for your local PBBS.

Where do you get it?

Every bulletin board I have seen has a user manual readily available for download. Most of the bulletin board systems have more than one function. In the case of the local system, there is a node available for connecting to other digital stations in the area or to other nodes. The node, in its simplest form, can be thought of as a repeater. The node has a different identifier—I can connect to it by telling my packet station to connect to CARSON. Once connected, a series of commands is available (see **Photo A**). These commands are similar, but not related, to the commands of the BBS.

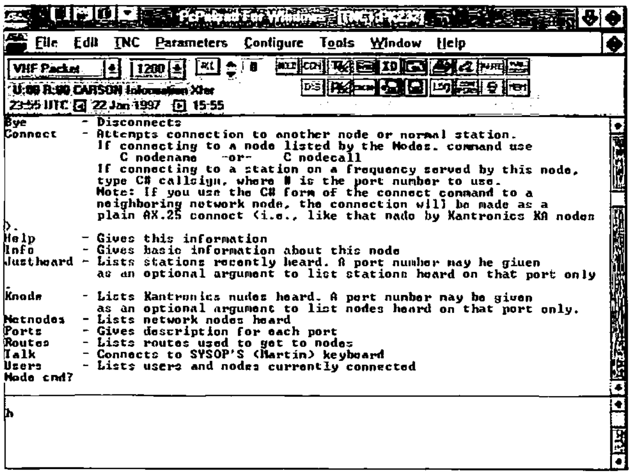


Photo A. Opening screen to node. A series of commands were listed after hitting Enter on a blank screen. One of these was Help. I merely typed the "h" in the lower "transmit" box, hit Enter, and slightly more than a screenful of instructions scrolled up the screen.

The bulletin board (PBBS) can be connected to after connecting to the node, so you can think of them as individual stations on the same frequency doing different jobs. If they are both busy, though, the throughput will be reduced because they follow a polite protocol and wait for each other to finish before they proceed with their particular task.

Intermingled with this is another function, the database. Your PBBS operator (sysop) has a computer dedicated to this entire operation and you have access to many files residing on his hard drive. One of these will be the user manual.

On the local system I found my user manual by typing the "W" command (**Photo B**). "W" is a pretty standard command used on many systems and it translates simply to What [is there?]. You will get a listing of the files and subdirectories of the database. In the local database, there is a file, USERMAN.DOC, and when I downloaded this I got a 24-page text of how to use the PBBS. You'd better believe that I printed it.

If your system does not have a "W" in the command line, type "H" for Help and it will reveal an abbreviated list of what all the commands can do. If you do not see a hint of where you might find a manual, send the sysop a message and tell him you are an avid reader and need this information for your library. He will tell you how to get it.

I learned, once again, how helpful and encouraging the ham community can be, when I first committed to enter the digital spectrum. I reside in an area where it's very difficult to make good solid contact with any VHF node, because this valley is surrounded by real mountains. That plays havoc with line-of-sight communications and especially with packet where the strings of information come in fairly long bursts.

To understand why that is a problem you need to understand a phenomenon known as multipath. You can work FM repeaters all over this neck of the woods and the multipath, though it exists, has little effect. With a packet transmission, however, it can be a disaster. Regardless of the power, if the signal bounces off a mountain, the received signal hits the antenna two or more times and turns the data string into mush—and software just can't decipher it.

A few years back, the closest PBBS was on the other side of the mountain. A direct connection was difficult to establish and nearly impossible to maintain. Transferring intelligible information was hopeless. I solved the problem for a time by setting up a digipeater out in the middle of the valley. It consisted of an IC2AT and an MFJ 1270 with a Commodore 64 to load software and monitor the activity.

This worked but it was slow and it was buggy. I frequently had to trek across town to reset the TNC, a great experience, because when you exercise the gray cells they get stronger—and I felt I had overcome the evil multipath demon. After a few years, I had to take the system down; it was at my business location and I decided to stop doing business. It was the best decision I made in years, but I was virtually out of packet radio.

To the rescue came a local ham who set up a PBBS, right in the line of sight I needed to regain access to the packet bulletin board system, and without having to go through two repeating processes. Working packet is now the pleasure it should be.

Those of you who use services such as CompuServe, AOL, and the Internet take a lot of this transfer of information for granted. The on-line services store and move massive amounts of data in

all forms, including text, graphics, and sound, accurately and speedily down the phone lines.

The amazing thing about this is that, except for the speed, we can do all this via our radio connections. That's right: Most of the data passed through the packet radio system is in basic text format with no fancy fonts, and the pictures, if drawn, are done with keyboard symbols. However, it is possible (and some hams are doing it) to move binary files such as word processor data, graphics, and even sound files through the packet system. And one day, maybe even the speed bumps will go away.

There is quite a proliferation of ham bulletin board programs, so it would not be reasonable to attempt to list all the variations of commands and what they do for each system. Here I find a command line listing with 21 of the 26 letters of the alphabet—and that's just the beginning. When you get the inside dope on these commands, many of them are combined with three or four other letters for variations of the command to help you become more efficient.

"A" is a nice simple command that stands for Abort the operation you have in progress. They can't fool with that. "B" is another common no-brainer that allows you to disconnect from the PBBS. Now "C" becomes another story. On a node it is used for connect, which seems straightforward enough. The system I am working into has some variations. If I were connected to the node and wished to connect to another node or station I would normally type in [C callsign]. This system requires a port number after the "C" and then the callsign.

When I connect to the PBBS, that "C" is another story. It then stands for conference. Well, not very many keyboard conferences are held, but there *is* a way and I guess this double use of letters just shows that we don't have enough letters in our alphabet.

Photos A and B are screen captures so you can have a look at my screens as I use my current (AEA) computer program. There are many good programs on the market these days. The best way to get comfortable with software is to find a neighboring ham who'll show you what he is using. If it looks like something you can handle, you have a built-in tutor. The next best is to jump in and figure it out on your own. It's not as difficult as it may seem.

If you are looking to get the most bang for your buck, there are several factors to consider. If you are going to concentrate on packet for the foreseeable future, several choices are available, including MFJ, Kantronics, BayCom and PacComm. If you can come up with a used TNC and need software, there is a good selection of packet software that won't put you in the poorhouse. You can buy all new (except for the radio) and get into packet these days for $50-150 (more about that part next month).

Hams use programs of all kinds, from telephone terminal programs to a variety of dedicated programs, such as the one I am using; they all tell the packet system at the node or PBBS the same commands. The fancier systems use the power of your computer to accomplish keyboard shortcuts so you can get on with your hamming and not spend all your time typing in commands.

Communications software used in ham radio isn't the same as in word processors or following hypertext links around on the Internet. This stuff forces you to get a little more involved. By that I mean it won't let you get away with a thing. If you want to use your computer for ham communications, at least study the operational commands and keep a list of them handy when you are making contact. When you first use any program, it is helpful to keep a few notes close to the keyboard until you get the hang of things.

As you may guess, the modern programs are equipped with help windows for ready reference, so you can usually look anything up within a half minute. In fact, it appears the entire instruction manual is contained in the help files, all categorized alphabetically. It is usually faster than finding the correct page in the hard copy manual.

I have occasionally had to eat a ration of humble pie for not remembering a command in the middle of a live contact on HF. If

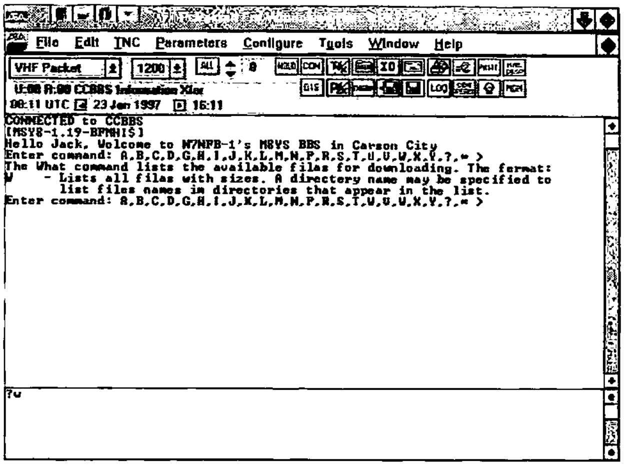


Photo B. Opening screen for BBS. The first four lines appeared, then I entered the "?w", pressed Enter, and it displayed information about the "W" command. Then it redisplayed the command line and is now waiting for the next command.

or when this happens to you, you'll find a lot of hams on the other end of the keyboard who are very reassuring, so don't be afraid to try something new.

Can we *talk?*

If you have questions or comments about this column, E-mail me at [jheller@sierra.net] and/or at CompuServe 72130,1352. I will be glad to share what I know or find a resource for you. On packet, when you get a chance, drop me a line at: [KB7NO@N7NPB.#NONEV.NV.USA.NOAM]. For now, 73, Jack KB7NO.

Number 58 on your Feedback card

Hams with Class

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Space Covers: History In Your Hands

Several years ago, Lynn A. Breece K4LFV, Lt. Col. USAF (Ret.), contacted me after reading several articles about my work with young people in ham radio and about my involvement with the space program.

Lynn began sending unusual and beautiful wall posters of the space shuttles to our classroom. One day, something really special arrived in the mail for the children. Our friend had meticulously collected and assembled two space cover albums for us. Space covers are special commemorative envelopes from the US Postal Service with the mission patch or insignia on them, that are canceled at the launch site. The two albums Lynn sent us contained space covers and memorabilia from STS-30 and STS-34. The children in my 6th, 7th, and 8th grade radio classes were delighted with the albums, which contained the canceled envelopes, newspaper clippings, and a collection of reports about the missions.

A letter writing exchange soon began between Lynn and my classes. The children eagerly looked forward to the many albums and kind letters he took the time to send to us. In October, 1991, Lynn wrote us a beautiful letter describing how he got started in the fascinating hobby of collecting space covers. The children and I agreed that Lynn Breece was one of the most interesting hams we had ever met.

In 1961 Lynn started working at Cape Canaveral and the Kennedy Space Center. At that time, the post office closest to the Cape was in Port Canaveral, Florida. For this reason, you can find covers canceled at Port Canaveral for the launch of Alan Shepard in the first Mercury capsule.

As the Mercury launches proceeded and the Gemini Program got underway in 1965, cancels began to come from the cities of Cape Canaveral, Cocoa Beach, Satellite Beach, and a few other towns which were close to the Cape.

In 1965, the post office at the Kennedy Space Center was opened so that all the NASA launches could then have a cancel from the Kennedy Space Center in Florida. It was standard practice for the post office to cancel covers on launch day as long as the covers were mailed before the set day or were hand-carried into the post office the day of the launch.

Lynn told us that in all the years he's been collecting covers, he has found postal employees to be very cooperative in supplying the proper cancels on the right date. He particularly praised Mr. Al Moore and his staff at the KSC post office for supplying superior service to collectors.

As the space program grew, more and more cover collectors appeared on the scene, including the strictly philatelic ones (collectors of postage stamps). This meant more cachets, different types of covers, and cancels from all sorts of places, such as a town where a particular astronaut was born.

Lynn chose to specialize in getting astronaut signatures on covers; but he also includes NASA officials, scientists involved in the program, cap coms, test directors, launch directors, etc.

The astronauts and others involved in the space program were always very happy to sign covers for Lynn. He wrote the children: "As someone who has lived most of my life in this century, I believe I have seen more history-making events than those living in previous centuries.

"When one considers the space program alone, think of what we have witnessed just in the last 36 years," Lynn points out. "Man's landing on the moon will go down in history as the single greatest scientific accomplishment of the century."

Lynn often followed up our letter exchanges with radio contacts to our classroom. He always felt that young people were the life blood of any organization or hobby. Without youngsters and the enthusiasm and energy they offer, a club or organization would eventually die out. These were always the things he and I would talk about through the three years we knew each other. Lynn was very interested in motivating young people to get involved in ham radio and in the space program.

He always encouraged the children to get involved by collecting space covers, attending launches, visiting NASA centers, reading about space, and talking to hams on the radio with mutual interests.

A ham since 1932, Lynn loved the idea of teaching ham radio to young adults, and continued to be supportive of my program until his death three years ago. His expressed admiration for the children who studied the theory and rules, and who practiced the code and got their licenses, was surpassed only by the warmth and respect my kids felt for Lynn. Through my radio classes, Lynn found an outlet through which he shared his enthusiasm and interest in space and ham radio.

Lynn always hoped that children would look at the past space covers and remember the events they mark. "To own a cover which was canceled on Moon Landing Day or on *Voyager*'s closest encounter with any of the planets is to hold a piece of history in your hands. It is a record of a great event, and one that will stand through the years." Lynn affirmed.

There is a permanent tribute to this wonderful ham friend in my classroom at Intermediate School 72 in Staten Island, New York. All the beautiful space cover albums Lynn sent us through the years are on display for students to keep enjoying and learning from. His love for space and radio will long be remembered and passed along to a whole new generation.

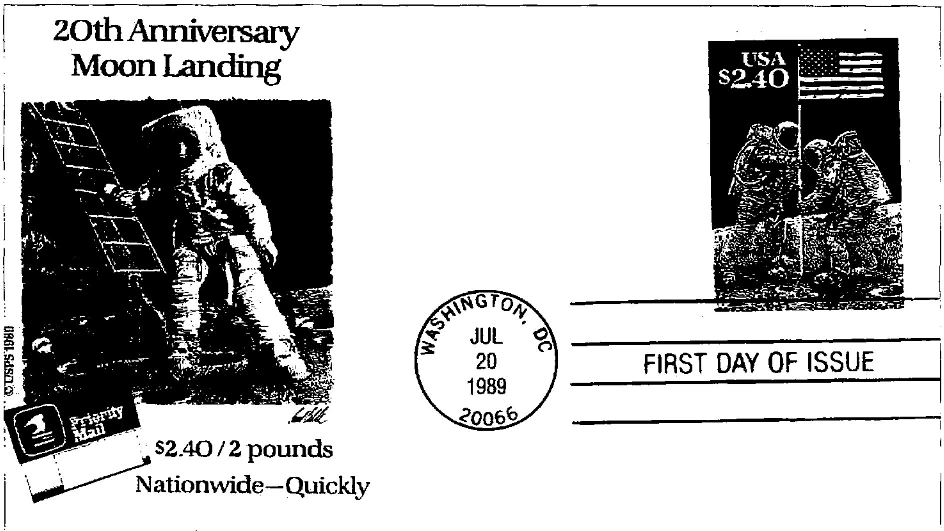


Fig. 1. Postal covers are commemorative envelopes issued by the US Postal Service in honor of historical events.

Number 59 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041
E-mail: carrjj@aol.com

More on ham software

Well, it seems that my complaints about ham software seem to have hit a resonant chord. I received a large amount of E-mail and snail mail from people with one complaint after another. The suspect software covered everything from antenna analysis to terminal node controllers to information databases. It seems that almost all forms of software were involved.

The most frequent complaint was on MS-DOS non-Windows© software. We are seven years into the Windows era, so there is no excuse for offering MS-DOS software any longer. Also, Windows software writing used to be a big deal, but now Visual Basic© and Visual C© are on the market and make the "...contriving of contrivances a game for all..." Visual Basic 5.0 should be out by now. It is said by beta testers to run as much as 20 times faster than VB4, and now competes with Visual C speedwise.

Some guidelines

I would like to offer some guidelines for developers of ham software. I would also like to hear from experienced software developers who have other ideas. Keep in mind that I am not sounding off from any "high horse," because I readily admit that I've made all the mistakes I've complained about in others. But I also bought some books on human computer interface design (see list below) and learned a bit of stuff.

The three pillars of design are usability, functionality and aesthetics:

• Usability means that users can easily learn to use the interface (screen) and then efficiently interact with it.

• Functionality refers the functions and controls that are available on the screen, and their optimal use.

• Aesthetics refers to the appearance, spatial layout, and color scheme. Ask whether or not it enhances or takes away usability and functionality.

Another attribute of a good program is consistency. It is very important to design the program so that the system always interprets user actions the same way from event to event. It should also respond the same way to different instances of the same event. If you make a change from expected behavior, or design an interface that does not match the Windows standard, then make it a large and obvious change so that users know it is not a standard presentation.

"There is no excuse for offering MS-DOS software any longer."

Color is one of the most frequent icky things about computer interface design, and leads to what one authority called "color pollution." Some people seem to think that the more color the better. Or that sexy-looking colors are neat to use.

Color should be used to make things stand out, especially at the specific times when needed. If there are too many colors on a screen ("color pollution"), then the user has a difficult time finding things. Normally, dim or dark colors (deep blue, Microsoft gray, etc.) are better for screens than most light colors. Also, solid colors generally work better than the pastel shades, especially where the standard 8-point type is used on labels placed on the screen.

Color differences can be quite useful when you segment a screen. You can use colors to divide a screen into separate tasks or classes of information. Also, it has been found that color works better for experienced users than for "newbies." If the principal audience is people with little computer experience, then stifle the color.

Long load times are often required for programs. Unfortunately, a long load keeps blank stuff on the screen and that makes users nervous. The user will then start hitting keys or clicking the mouse inappropriately and make the program do odd things. About ten seconds' load time is considered excessive by most users. There are several things that can be done about it:

• First, a splash screen can be provided. This is a screen, usually without borders, that appears as soon as the program loads. It remains on until the entire program is loaded. It typically does not have graphics or any controls because these take too long for loading. In some cases, a 200-mS (or so) timer control (as in Visual Basic) may be used to load the rest of the program from the splash screen Load Event.

• Another trick that can be used is to provide a progress bar. That's one of those green or blue bar graphs that show the percentage of completion. Alternatively, an on-screen message could be provided.

Some questions that you should ask include:

• Does a desired feature have a performance effect? If not, then dump it unless there is a good reason to keep it.

• Is the feature likely to confuse the user? If it does, dump it or redesign it.

• Are any of the controls, functions, or features non-value-adding? If so, then dump them.

• Can controls be combined or eliminated? If so, do so.

• Is the interface as intuitive as possible to the user? If not, redesign it. For the most part, this means that the program should follow the Windows standard format because that is what the user will understand.

Testing

Testing is a necessary although often not sufficient means for telling how well the program works and ferreting out bugs. Unfortunately, most ham software seems to be tested by the programmer, rather than by a typical user. Programmers make lousy testers because they are usually too close to the program. They can easily overlook obvious problems because they have little mental workarounds. They know how the program is supposed to work, so they may overlook some obvious errors that typical users might make. They are also confident using computers, where real users might be frightened of the machine. The goal is to make the user population as representative of the customer population as possible, even if it means giving away free beta testing copies.

Observing testers can sometimes be a problem. The tasks they are asked to perform should be realistic and truly representative of the tasks normal users will face. The tasks should also cover the full range of possible situations, although my answer to trying to figure all of them out is, "Good *luck*!" Also, the observer should be as unobtrusive as possible. The presence of the observer should in no way alter the performance of the user. In general, having someone looking over the tester's shoulder will induce more errors than is normal.

Books on human computer interface design and related topics

Laurel, Brenda (1990). *The Art of Human Computer Interface Design*. Apple Computer (republished by Addison-Wesley).

Preece, Jenny (1994). *Human Computer Interaction*. Addison-Wesley.

Tufte. Edward R. (1990). *Envisioning Information*. Cheshire CT: Graphics Press.

Tufte, Edward R. (1983). *The Visual Display of Quantitative Information*. Cheshire CT: Graphics Press.

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

How about some more good, down-to-earth tips and ideas to make our hobby more enjoyable and perhaps make it run a little more smoothly? And speaking of running, I'm running a little low on ideas, so please don't put off sending your favorites. Just jot down some things that have made ham radio problem-solving easier for you or for one of your friends, and send them to me at the address above. Uncle Wayne's elves will send you a check for $10 each so that you can afford to buy a couple of the books on his "must read" list. He's recommended some very interesting ones... and here are some other interesting tips:

Superman's AA cells

Looking for a super-capacity AA cell? If you use rechargeable AA cells in any of your portable gear, as I do, it might be worthwhile checking out the relatively new line of NIMH (nickel metal hydride) rechargeable cells. The NIMH chemistry automatically increases the mAH (milliampere-hour) capacity of a rechargeable cell by roughly 25%, and the new AA size NIMH cells boast an 1,100 mAH capacity (a 250-mAH increase over even their newer 850-mAH NiCd counterparts). NIMH cells can be charged in the same manner as NiCds, using a one-tenth-capacity constant-current charger (110 mA constant-current for the 1,100 mAH NIMH cells mentioned). The NIMH chemistry has less tendency toward "memory effect" than does the NiCd formula and the cells can withstand more heat. All in all, a worthy competitor to the venerable mainstay of our rechargeable repertoire of cell chemistries. One source of rechargeable NIMH "AA" cells is DC Ace Electronics (847-821-8122), who lists the 850-mAH "AA" NiCds at $2 each and the 1,100-mAH "AA" NIMHs at $2.50. When you compare these prices against the name-brand "use-em-once-&-toss-'em-away" alkaline cells, the choice is pretty clear... especially for battery-operated equipment that's used a lot. Though the better alkaline "AA" cells are rated at 2,450-mAH capacity, 2 or 3 uses from the NIMH cells will quickly put you in the "money-ahead" bracket. **Fig. 1** shows the basic constant-current NIMH 110-mA "safe" charger that I've been using for the "AA" cells in my GPS receiver.–**de Dave NZ9E.**

"When you compare these to the name-brand alkalines, the choice is pretty clear... "

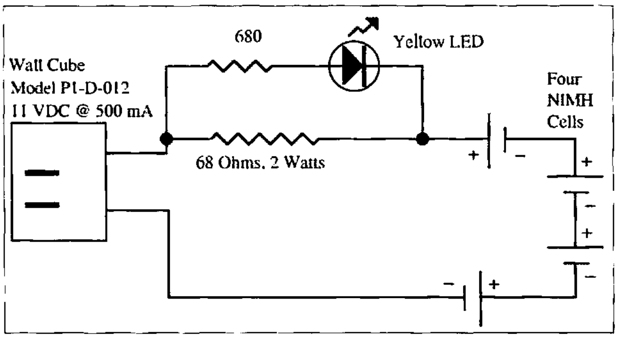


Fig. 1. A constant-current (110-mA) nickel metal hydride charger circuit suitable for charging four NIMH cells in series. The value of the 68-ohm resistor may need to be adjusted to achieve 110 mA, depending upon the characteristics of the transformer that's used. See text for further details.

CBer's PL

From Gary Holoubek WB6GCT: "Ever heard of 'CBer's PL'? That's the name I've given to the alternator whine that can be heard on all too many of even the best of ham radio mobile installations, and nearly all CB mobile signals! I thought I knew all about such problems until I installed a bank of radios into a friend's 1990 Lumina. My friend and I both enjoy having 3-band capability (146, 220, 440 MHz) in our mobiles, and it took me several days to design and build the hardware to stack the equipment between the vehicle's floor and dashboard in a neat vertical rack array. Today's small cars can often be a real challenge! Everything worked fine... that is, until I did some customization... and that's when Murphy struck!

"Knowing that microphones sometimes never make it back to their correct hangers, and with use, could become a confusing tangle of microphones and coil-cables, I decided to use only one microphone for all three radios and switch it to the desired transceiver with a rotary selector switch mounted in a mini-box. The three transceivers are all Yaesu, and fortunately, they use the same type of microphone and pinout connections. Sounds simple enough!

"The microphones are of the 8-wire type, with signals for microphone audio, up/down frequency control, speaker audio, +5 volts for powering the Touchtone® circuit in the microphone, and of course a common ground for everything. With a little bit of imagination, I thought of all the different things I could possibly do to make this a really whiz-bang installation. Realizing that the radios would be used at night and the position of the transmitter selector switch knob would not be easily visible, I decided to use the +5 volts in the mike cable to power three LEDs... which would indicate which transmitter the microphone was delegated to. I even used a different colored LED on the switchbox for each of the three transmitters. This would allow the operator/driver to determine which transmitter was 'ready-to-go' at a glance. It worked great! Even the speaker outputs from each radio were run through the switching box and an output jack made available to drive either an external speaker or a headphone for 'silent running'... all automatically switched with the microphone. Hey, no telling what an engineer can do with a little time and imagination!

"When all was said and done, I ran into an interesting problem, something I'd not anticipated. At times, when switching the microphone via the switchbox, the transceivers would key into transmit briefly. I theorized that the problem stemmed from the fact that the Touchtone keying circuit in the mike—which was powered by the transceiver's +5 volts—would create a spike on the +5 volt line as the switch was rotated and the power to the mike's TT circuit was pulsed on and off (I was using a break-before-make rotary switch). After installing three diodes, so that the microphone could draw power from all three radios but without allowing the +5 volts from one radio get into another, the problem disappeared. One of those 'little things' that doesn't show up until you actually put an idea into practice!

"Now everything was working fine until my friend actually drove the car! Yep, you guessed it. 'CBer's PL.' But I couldn't see how the alternator whine was getting into the transceiver's audio. I had brought the power for the transceivers directly from the battery and had even used a 30-amp relay to switch the rigs on and off with the ignition key... same as the regular car AM/FM radio. This allowed my friend to keep the audio volume controls in the same position and ensured that all of the rigs were OFF when leaving the car, and ON whenever the ignition was ON. I even installed a switch on the radio console to select either the ignition switch or direct battery power to enable the relay. That way the radio stack could be powered up without the

ignition key for those times when operating mobile at a fixed position (as might be done during extended public service duty) was called for.

"In trying to figure out just what was causing the 'CBer's PL' problem, I did what every budding engineer (?) does when he has a problem. I talked it over with anyone who would listen! Following the suggestion of another technically-oriented ham-friend, I disconnected the two unused mike cables that run between the switchbox and the transceivers, leaving only the active one in use. No help. Of course, the alternator whine was gone with the microphone connected directly to the transceiver, bypassing the switchbox entirely...but the switchbox was such a neat idea!

"So one weekend, armed with a portable scanner receiver set to the transmitting frequency in hand, I decided to get to the bottom of the problem. First, I found that removing the metal box from the radio stacking bracket (i.e., simply ungrounding it from the vehicle's frame) eliminated most of the noise. Interesting! Now, disconnecting the unused radios removed all the rest of the annoying whine. Even more interesting! It turns out that what I had done was to connect all of the grounds together inside the switchbox and then ground them to the metal switchbox itself, so that everything would be shielded from any source of noise. So much for that great idea! Instead, I now disconnected all the grounds from each other and from the box ground, and routed them through the rotary switch instead (fortunately, I had an extra set of contacts to do it). Now, none of the microphone cable grounds were connected to the switchbox or to each other any longer... and that turned out to be the final cure.

"Everything was working fine until my friend actually drove the car."

"Here's what was happening: As we all learned in basic electricity, electrons will take any and all paths available to them to get to wherever they are going. Now since the alternator is mounted on the engine, and thus grounded to the engine, and the vehicle's negative battery terminal is also grounded to the engine via a nice thick cable, a classical ground loop was set to exhibit itself. And it waited there patiently just for me to come along!

"The bulk of the alternator's ground current will travel via the heavy cable to the battery. But what I had done by grounding the switchbox to the radio stack bracket was to provide another path for the electrons to get to the battery via the car frame ground in the switchbox; then to the transceivers via the microphone cables; and finally to the battery via the transceivers' power wiring. Admittedly, the actual current through the microphone cable was probably small, but not all that much is needed since the microphone is a low-level circuit whose audio is greatly amplified... along with any noise in the form of alternator whine. End of mystery!

"If you would like more exact details on how I connected everything up, or on where I found the parts to do it, etc., just send me an SASE (self-addressed, stamped envelope). I'll tell you all about it—perhaps more than you care to hear! I hope these tips and experiences prove helpful at some time to other *73* readers."

Moderator's note: Interesting story, Gary—thanks for sharing it with us. Gary's experiences are a good lesson for all of us to keep in mind. It pays to watch for those sneaky multiple ground paths, especially where very low-level audio circuits are concerned. It also illustrates how every problem (hopefully) has a solution waiting to be found in a regimen of logical thinking and practical troubleshooting approaches. Sleeping on it often helps, too!

Cleaning pots...but not pans

From Richard Measures AG6K: "Noisy or intermittent front-panel control potentiometers

on today's ham transceivers can sometimes make operation frustrating instead of the joy it should be. The reason for the intermittent pots can often be traced to the grease originally used to lubricate them becoming sticky and gummy with age and the effects of oxidation. This in turn causes the contact between the rotating wiper-arm and the resistance-film to suffer, making poor or even no contact at times.

"One cure is to stand the set up on its back, using thick padding or the original packing foam as a protective cushion, and then carefully remove the knobs from the offending controls. Using a syringe with a small-gauge needle, inject TCE degreaser down into the clearance spaces next to the concentric shafts of the pot or pots you wish to clean. Once the degreaser has penetrated, rotate the shafts back and forth a number of times to work the cleaner in and to loosen the gummy grease. When the pot has been thoroughly 'exercised,' inject a bit of GC Electronics deoxidizing cleaner or one of the other newer products that are now on the market. The GC Electronics material can be thinned with about 50% TCE to help it penetrate down into the tiny clearance areas between the pot's shafts if necessary. Caution: TCE is considered to be carcinogenic and should be used only in a well ventilated area, with tools and hands thoroughly cleaned afterward. Wearing disposable latex gloves will help to protect you even more effectively by preventing absorption into the pores of your hands.

"Once you've completed the procedure, turn the set back on and check for any further intermittent action in the cleaned pots, repeating the operation if needed. This is a good deal quicker and less costly than replacing the potentiometers, and should keep them working properly for a number of years to come."

Moderator's note: Pots on equipment used in a mobile environment may need this treatment even more frequently due to the rigors of heat, cold, and dust that are often present in a mobile installation. In fact, even fairly new rigs will exhibit very "stiff" control action when the winter temperatures drop below zero in the northern areas of the country, often requiring this "de-gumming" sooner than home-based equipment. Radio Shack™ now sells several cleaning chemicals that can also be tried—some are "plastic-safe" as well as EPA-approved. Another brand worth looking at is made by Caig Laboratories of San Diego CA (800-224-4123 or 619-451-1799). It goes under their brand name of DeoxIT™. DeoxIT is a deoxidizing solution that cleans, preserves, lubricates and improves conductivity, all in one treatment. Using the procedure outlined by Rich, however, will pretty well assure you of getting the cleaner into the right spot—not everywhere else that you don't want it to be!

Good labels

From Phil Salas AD5X: "For labeling front panels on my homebrew projects, I create a full-size front-panel sheet on my computer with all the labeling neatly done, and then I print it out on a laser printer. I make the sheet slightly smaller than the front panel itself, then cover it with clear shelf paper lining... with enough overlap to hold it to the front panel. This clear shelf paper lining is very inexpensive. You can buy a large roll of it at most grocery stores, in the kitchen sundries section, for about $3 or so. The switches, indicators, connectors, and so forth on the front panel itself will contribute to holding the sheet firmly in place. You could also apply some type of glue to the back of the paper, although I've not really found that to be necessary."

Moderator's note: 3M™ also makes a Scotch™ brand double-stick tape that may work in conjunction with Phil's suggestion: their No. 66 series tape, available in most office supply stores. It's a clear-film type that's adhesive on both sides, and small strips of it can be placed on the back of the areas where a wide expanse might otherwise result in buckling. I've also used the clear, self-adhesive covering made by Contact™ as a protective film for panel labels and other paper surfaces that I've wanted to preserve from wear and tear. It can be found in most hardware and variety stores.

Color me DEKA

From George Primavera WA2RCB: A tip for changing the hue of incandescent lamps used in radio LCD edge-lit displays, meters, dials, and many other places: "My Kenwood TM-241A 2-meter rig came with the standard edge-lit LCD display. The first thing I noticed was that the white incandescent edge-lit LCD was a bit distracting in the car at night, even with the dial dimmer turned down to the low back-light setting. What it needed was a coloration on the edge-lighting bulbs that was more night-vision friendly! A trip to our local art supply store netted a variety of colored (but still transparent) glass paint bottles under the 'DEKA' brand name (made by Decart USA, Inc., Lamoille Industrial Park, Box 309, Morrisville, VT 05661). DEKA is a color base 'paint' used by artists to paint pictures on glass, but I found that the 'paint' could also be useful for adding a nice color-tint to the miniature incandescent lamps used in my 2-meter rig.

"The procedure itself is very easy. First remove the bulb(s) that you want to color-tint, then grip them by their wire leads, using an alligator clip. With the leads pointing up, dip the bulb directly into the bottle of glass 'paint,' taking care to not get any paint on the wire leads themselves... the bulb should be dipped into the paint up to about 3/4 of its length.

"Now touch the tip of the bulb to a clean piece of metal once or twice to remove any excess paint from the bulb's tip-end, then wedge the alligator clip holding the bulb under some heavy object (miniature organizer drawers work well) to hold it in place. The bulb should be suspended in 'midair' and allowed to dry overnight (generally eight hours is the minimum drying time, depending upon temperature and humidity). Next, simply reinstall the bulb back into the radio from whence it came, reassemble everything, and turn it on. My TM-241A now sports a nice pumpkin-orange tint on its LCD, thanks to the newly colored backlight. It's noticeably less distracting while driving at night in a mostly darkened passenger compartment.

"A few precautions on this procedure should be mentioned: *Do not* color-tint any lamp larger in size than three watts, nor one that normally gets warmer than you would be able to touch safely while in operation. I've had no problems with the grain-of-wheat bulbs used in radios, or with #47 pilot lamps used as panel indicators, but automotive-type lamps (such as 1157) get much too hot. The paint will flake off from the excess heat in just a short time. Also, *never* apply this treatment to *any* kind of halogen lamp. Halogen bulbs must be meticulously free of any foreign substances on their glass or they can shatter violently! The colors that I've found to work best are #30—Light Blue, #27—Orange, #26—Lemon and #28—Light Red. Note that lamps treated with the #30—Light Blue color will have a reduction of about 60% in their visible light output.

"I'd recommend using this procedure on glass bulbs only if you try it on a 'throw-away' first. Plastic-encapsulated light devices, such as LEDs, might be chemically attacked by the solvent base of the glass paint."

Recycled tubing

From Bob Boehm N8EXF: "The plastic tubing used in hospitals and nursing homes can often have applicability to our hobby! The rippled hose used for oxygen transfer to a patient can often be salvaged for use as a plastic conduit for running cables in your ham shack or perhaps in a mobile installation. The hosing can be used as is, or slit with a sharp knife along its length so that wires and cables can be tucked into it and given additional protection in harsh environments. Or maybe you can just keep those wires and cables a little neater-looking for appearance's sake...

"Likewise, the smaller-diameter plastic tubing used for intravenous feeding, etc., makes great insulated, protective tubing for a number of ham and electronic applications. I use a length of it over my HF mobile whip antenna to act as a cushion between the whipping antenna radiator and the painted body of my van. The thick plastic tubing keeps the bouncing whip from marring the paint job on the back of my van very nicely. Generally, these hospital throw-aways are made of good-quality plastic material and should last for a number of years of exposure to the extremes of weather and friction. Give it a try."

Moderator's note: I like Bob's idea. I saved some of the small tubing from my own hospital stay a number of years ago and have used it in numerous

"Halogen bulbs must be clean, or they will shatter violently!"

applications since that time. The lengths are usually long enough to protect a vertically rising antenna wire from direct contact by the inquisitive fingers of neighborhood children (or paws of pets), and you surely can't beat the price! [That may be subject to debate.—Ed.]

Murphy's Corollary: Everyone has a foolproof scheme. It's easy to spot... it's usually the one that isn't working!

A very special thanks to this month's contributors:

Gary Holoubek WB6GCT
1961 Evergreen Avenue
Fullerton CA 92635

Richard L. Measures AG6K
6455 La Cumbre Road
Somis CA 93066

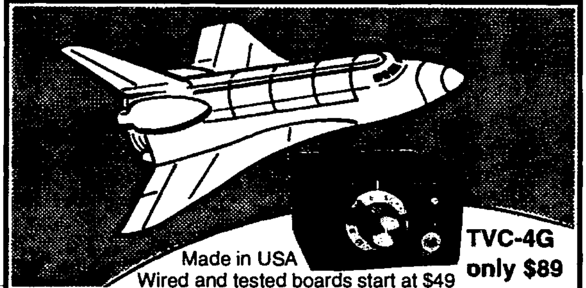
Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

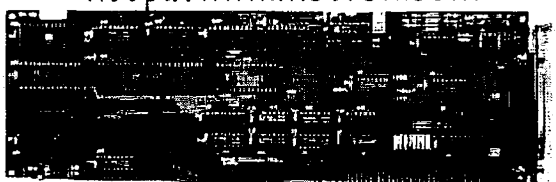
George Primavera WA2RCB
830 Park Drive
Cherry Hill NJ 08002
Packet address:
[WA2RCB@KE3CZ.#EPA.PA.USA.NOAM]

Bob Boehm N8EXF
6821 Le Conte Avenue
Cincinnati OH 45230-2935

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or 73 for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to the moderator at the address shown at top. All contributions used in the column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but please be sure to send all specific questions on any particular tip to the originator of the idea, not to the column's moderator nor to *73*. 73





Number 64 on your Feedback card

Communications Simplified, Part 17

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

Optical Fibers

As fiber optic cables fall in price, they are being used more and more for communications. In a nutshell, electrical signals are converted into a light beam (possibly visible, but more likely infrared) with an LED (light-emitting diode) or laser; the light beam is sent through a fiber made of glass or plastic; and then it's converted back into an electrical signal with a photodiode or phototransistor. Thus the fiber cable simply replaces the copper wire.

The optical fiber, however, has a number of features that make it superior for some applications. For one, its attenuation is much, much lower than that of cable, especially at high bandwidths. It is entirely practical to send high-speed data or analog signals some 30 to 40 miles without needing to amplify or regenerate signals along the way.

Optical fibers also offer immunity to electrical interference. They do not leak energy outward, are extremely difficult to tap, and do not accept interference from other nearby signals. They are also immune to nearby lightning strikes, although this is sometimes compromised by cables that contain both optical fibers as well as electrical conductors inside the same cable.

Fiber optic cables can be made of either glass or plastic. A typical cable generally looks like **Fig. 1**, and consists of three parts:

a. The core is at the center. Made of very pure, clear glass or plastic, the core passes the light beam from one end of the fiber to the other.

b. The cladding is a second layer of glass or plastic, wrapped around the core. This layer is made of a slightly different glass or plastic, one that lets light travel just a bit faster than the core.

c. The jacket covers the outside of the fiber and protects it. In some fibers, additional jacket layers, including perhaps even metal sheathing, may provide additional protection.

To understand how this works, imagine that we are laying out an automobile race course. In order to keep cars from straying off course, we construct it as shown in **Fig. 2**. In the middle is the race course itself, constructed of a very smooth surface designed for minimum friction. This is where we want each car to drive.

On each side of the racing lane we put a second lane made of a slightly different material, one which provides slightly better traction. This is labeled the speedup lane in the figure. Finally, at the very edge, just in case a car gets too far off course, we'll put a layer of sand to stop it so it can't wander back into the course and get in someone else's way.

So now look at car 1, which has somehow gotten slightly off course. As soon as it enters the speedup lane, the left wheels will have slightly better traction than the right wheels, so its left side will wind up traveling just a bit faster. This is going to turn it slightly to the right, so it goes back onto the racing lane. Car 2, on the other hand, is so far off course that it too will turn a bit to its right, but not

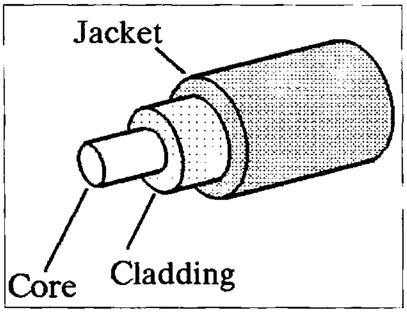


Fig. 1. Optical fiber construction.

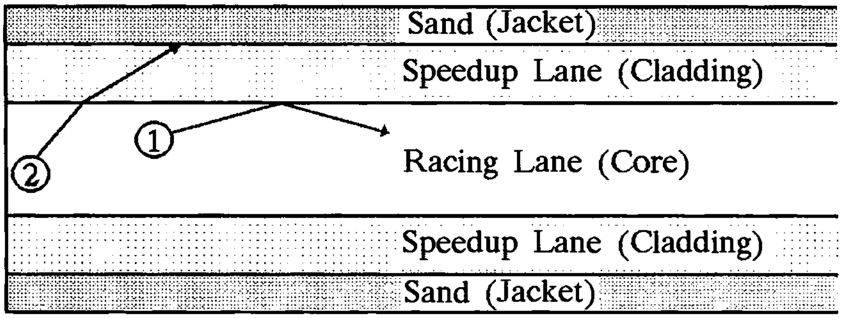


Fig. 2. Keeping a ray on track.

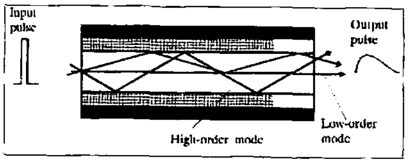


Fig. 3. Multi-mode fiber.

enough to return to the course. It will eventually get stuck in the sand, and that will keep it out of trouble.

Thus the speedup lane keeps the cars from straying off course, without any intervention on their part. You could almost put a blindfolded driver into a car, and the course itself would keep him on track.

The optical fiber works exactly the same way. The cladding is made from a glass that lets light travel just a bit faster than the core. In terms of physics, the core has a slightly higher index of refraction than the cladding; this makes light travel slightly more slowly in the core than in the cladding. When a ray of light tries to leave the core and enter the cladding, it is bent back just enough to reenter the core. If it's like car 1, it returns to the core and keeps going. But if it's like car 2, then it goes right through the cladding until it hits the jacket, and gets stopped.

It is important to realize that the process of "bouncing" off the cladding back into the core is not the same as reflection off a mirror. Reflection in a mirror always loses a small amount, since no mirror is perfect. Refraction, as it is called, is 100% efficient—there is no light lost in the process. The only light that is lost is due to any impurities in the glass.

Fiber optic cables can actually be made from either glass or plastic. As such, they come in three types:

•All glass is best, and most expensive.

•All plastic is worst, but cheapest.

•Plastic-clad silica (PCS) is a compromise, where the core is quartz-like form of glass called silica, but the cladding is plastic.

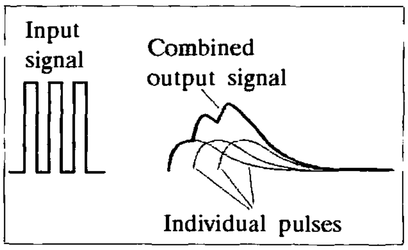


Fig. 4. Dispersion spreads pulses.

The difference is primarily due to the fact that glass is clearer, and therefore significantly more light gets through the fiber. Because of the loss of light, plastic fibers are only usable in short lengths of a few hundred feet, whereas glass fibers can be dozens of miles long.

Transmission modes

Referring to **Fig. 2**, we can see that a car which goes straight down the core will make better time than a car which constantly bounces from edge to edge. This is an extremely important concept in optical fibers as well, because it determines the dispersion of light.

Fig. 3 shows a stepped-index or multi-mode fiber. It is called stepped-index because there is a sudden change (mathematicians call it a step) in the index between the core and the cladding; it is called multi-mode because it permits many modes. The mode describes the path that a light beam takes: a low-order mode is one that goes directly through, taking as few bounces as possible. A high-order mode is one that takes many bounces before arriving at the far end. Obviously, a high-order mode light ray must travel a greater distance to the far end, and so arrives later than a low-order light ray. If the light is pulsed on and off, as shown at the left, the pulse arrives at the far end spread out, as shown at the right. The term dispersion describes how spread out the pulse is at the output.

The amount of dispersion depends on the length of the fiber. When a fiber is short, the difference between a low-order path and a high-order path is fairly small, so the total dispersion is fairly small as well. The longer the fiber, the greater the difference in path length, and therefore the greater the dispersion.

Fig. 4 shows why dispersion is a problem. Most fiber optic cables are used for digital signals; the bandwidth of such a cable depends on how many pulses can be sent per second. When a fast series of such pulses is sent through the cable, dispersion spreads out each pulse as shown. The pulses then overlap, making it harder to properly separate and detect them. When dispersion makes adjacent pulses blend together too much, the only solution is to separate the pulses farther apart. This limits the number of pulses that can be sent per second. In other words, the bandwidth of the fiber depends on its dispersion, which in turn depends on its length—the greater the length, the lower the bandwidth.

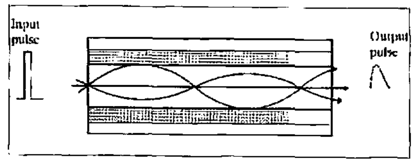


Fig. 5. Graded-index fiber.

A graded-index fiber **(Fig. 5)** is a partial solution to the problem. Rather than having a sudden change in the index of refraction between the core and the cladding, the graded-index fiber has a gradual change in the index. This has two effects. First, it results in the light rays gradually bending back toward the middle, rather than abruptly "bouncing" back and forth. This tends to gradually straighten out the light path, causing more of the rays to travel along low-order modes rather than high-order paths. A more important effect is caused by the fact that the index of refraction is highest in the middle of the fiber, and gradually decreases as you go outward. Light rays traveling toward the edges of the fiber therefore move faster than those in the middle. Even though they travel a longer distance, the faster speed lets them catch up with the lower mode rays in the center. The result is less dispersion.

The best solution to the dispersion problem is with a single-mode fiber; a fiber which has only a single possible mode of light transmission. Just as two out-of-phase electrical signals can cancel, so two out-of-phase light rays can cancel. Because of this interference effect, there are only certain specific light paths (modes) in a fiber which are possible; all others cancel out because of interference. If the core is made thin enough, the only mode that is possible is the one straight-through mode in the middle. The resulting single-mode fiber, shown in **Fig. 6**, thus has much less dispersion and therefore a higher bandwidth.

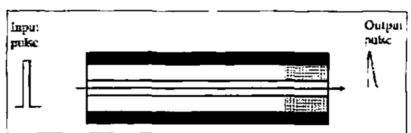


Fig. 6. Single-mode fiber.

You can understand, though, that a very thin single-mode fiber will let through much less light than a thicker multi-mode or graded-index fiber. For that reason, single-mode fiber generally requires a glass core which, because of its clarity, attenuates the light less. Plastic fibers, on the other hand, are usually thicker to let through more light. This increases dispersion and thus reduces their bandwidth, but this is not much of a problem because their attenuation is so high that they can only be used in shorter lengths; at these lengths, dispersion is not as bad as it would be in *very* long lengths.

Fiber characteristics

Let us next look at some characteristics of actual fibers of various kinds, listed in **Table 1**.

Core and cladding diameter

Fiber diameters are given in µm or micrometers—10^{-6} meters. To put this into context, note that a typical human hair is about 50 µm thick, so the thinnest fibers are about 1/10 of the thickness of a hair. Fiber dimensions are usually stated as two numbers separated by a slash; that is, a 50/125 fiber has a 50-µm core diameter and a 125-µm cladding diameter.

In general, the plastic fibers are much thicker than the glass fibers, although multi-mode glass fibers can also be quite thick. The thinner fibers obviously must be much clearer to let through enough light.

Attenuation

The attenuation determines how long a cable can be used before the signal becomes too small to be useful. It is rated in dB of signal loss per kilometer of length. The best glass fibers have losses below 0.5 dB per kilometer, whereas some of the plastic fibers have losses of as much as 400 dB per km.

The best glass fibers are amazingly clear—a 6-km length of glass single-mode fiber, about 4 miles, would have a loss of about 3 dB. To realize just how amazing this is, think of a piece of window glass 4 miles thick. With ordinary glass, you probably would not even be able to detect light through it. With a fiber, a 3-dB loss means that half of the light entering it comes out the far side!

Even with 30-mile lengths (about 50 km) of a good glass fiber, the loss is only some 20 or so dB—a loss of 99% of the light power, but still within a reasonable range. Plastic fibers, on the other hand, can have huge losses. At 400 dB per km, 20-dB loss would occur in about 1/20 km, or about 150 feet. Because of this high loss, the maximum usable length of a plastic fiber is a few hundred feet—long enough to go within a small building, but not much more.

Type	Core Diameter (µm)	Cladding Diameter (µm)	Attenuation (dB/km)	BW MHz•km	NA
Single mode glass	5	125	0.5	1000+	small
	8	125	0.4	1000+	small
Graded index glass	50	125	4	400	.20
	63	125	7	250	.29
	85	125	6	200	.26
	100	140	5	20	.30
Multimode glass	200	380	6	25	.27
	300	440	6	20	.27
Multimode PCS	200	550	10	15	.30
	800	900	6	20	.30
Multimode plastic	980	1000	400	20	.50

Table 1. *Optical fiber characteristics.*

It is interesting to compare fiber attenuation with the attenuation in copper cables. The attenuation of copper cables increases with the frequency of the signal. For example, good quality RG-8 with a foam dielectric has about 1.2 dB loss per 100 feet at 50 MHz, about 2 dB loss at 150 MHz, and 3 dB loss at about 300 MHz.

Let's look only at the loss at 50 MHz, since that is close to the 47.736 MHz data rate of a T3 line, a common data speed in optical fibers. Since there are about 3300 feet in a kilometer, a 1-km length of RG-8 would have about 40-dB loss at 50 MHz. Even one of the best and most expensive coax cables (7/8-inch-diameter hardline) would have a loss of 12 dB per km at 50 MHz. Compare this with the 0.5 dB per kilometer loss of a good glass optical fiber, and you can clearly see the advantages of fibers over long distances.

Attenuation vs. frequency

As we just mentioned, the attenuation in copper cables depends greatly on the frequency, and therefore affects the bandwidth. As the frequency increases, the attenuation goes up very fast, and this greatly limits the bandwidth.

When talking about fiber cables, however, we must be careful, because there are two frequencies to consider—the frequency of the light (which actually describes the light's color), and the frequency of the data (which describes how fast the light is turned on and off in the case of digital data, or how fast its intensity changes in the case of analog data). Rather than use frequency, however, physicists use the wavelength since it is easier to measure (as you remember, the wavelength is the velocity divided by the frequency, so it is easy to convert back and forth). The wavelength is measured in nanometers or nm (one nm is 10^{-9} meters), and the colors measure approximately as follows:

- Ultraviolet: shorter than 400 nm
- Violet: 400-450 nm
- Blue: 450-500 nm
- Green: 500-570 nm
- Yellow: 570-590 nm
- Orange: 590-610 nm
- Red: 610-750 nm

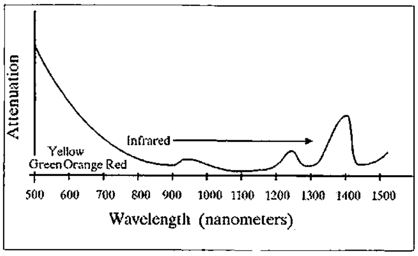


Fig. 7. Attenuation of glass fiber.

•Infrared: from about 750 to about 1400 nm

(Ultraviolet and infrared wavelengths are also considered to be light, but they are invisible to the eye.)

Light's wavelengths are so short that they are greatly affected by molecular and atomic characteristics of materials. For example, **Fig. 7** shows the attenuation of glass at various wavelengths. We see that the attenuation varies quite a bit with wavelength. At very short wavelengths (toward the left of the graph), light transmission is affected by individual atoms—the farther left you go, the greater the attenuation, so these wavelengths are not very useful for optical fibers. At longer wavelengths (toward the right), light transmission is affected by certain combinations of atoms, and so there are specific wavelengths that are highly attenuated, while other nearby wavelengths get through with relative ease. As long as we stay away from these attenuation peaks, the red and infrared wavelengths will work best.

This is fortunate, because LEDs and diode lasers are easier to build, more efficient, and cheaper at infrared and deep red colors. Glass fibers are generally used with infrared light between 790 and 1300 nm because that is where the attenuation is least. Plastic fibers, on the other hand, are usually used with red light at about 650 nm.

Note that it is possible to send several different colors through a fiber cable at the same time, as long as we choose the colors wisely. Thus it is possible to send two or more different signals through the cable. Still, this is not too common in longer cables, because feeding two or more color sources into the same fiber, and then separating them again with colored filters, introduces losses that limit the distance.

The attenuation of various colors is thus a separate topic from the concept of signal bandwidth.

Signal bandwidth

The bandwidth of a fiber is related to how fast we can turn a beam on and off, or more likely, how fast we can change its brightness (because even in digital applications, the beam is usually switched between bright and dim, rather than between bright and off).

This speed is determined by two factors: the speed at which the light sources and detectors can work, and the dispersion in the fiber itself.

As we showed in **Fig. 4,** dispersion makes adjacent pulses blend together; they therefore have to be separated farther apart.

Since the dispersion increases with the length of a fiber, the pulse rate for a given fiber is inversely proportional to the distance. If the length (in km) is large, the frequency at which we can switch the beam (in MHz) is small, and vice versa. The product of these two quantities is therefore fairly constant for a given fiber, and is given in "MHz times km" or MHz•km. This number is listed in the bandwidth column of **Table 1**.

For example, the bandwidth for single-mode glass fiber is shown as 1000+ MHz•km (the + means that it is 1000 or greater). Assuming a value of an even 1000, a 1-km length of fiber would have a bandwidth of 1000 MHz; a 10-km length would work up to 100 MHz; and so on.

Compared with 1000+, the rating of 20 MHz•km for multi-mode plastic fiber looks awful... until we put it into context. Remember that, because of its attenuation, plastic fiber is limited to a small fraction of a kilometer. For instance, consider a plastic fiber 1/20 km long; at that length, the bandwidth is still a respectable 400 MHz (since 400 MHz times 1/20 km is 20 MHz•km). Thus plastic fiber can also be used for high bandwidths, but clearly only for short distances.

This helps to explain why no one bothers to make single-mode plastic fibers—there is simply no way to take advantage of the lower dispersion that this would provide.

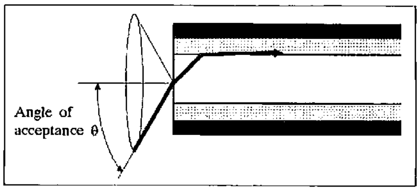


Fig. 8. Numerical aperture with cone of acceptance.

NA or numerical aperture

The last column in **Table 1** shows the numerical aperture for various fibers. The meaning of this measurement is shown in **Fig. 8**.

The dark line at the left in the figure shows a light ray which comes into the fiber at such a steep angle that it hits the cladding and stays there; it does not "bounce" off it back into the core. Clearly such a light ray is not going to make it to the far end. Furthermore, any other light ray that is at that angle or more will not make it through either.

The result is that there is what we call an *angle of acceptance* q, which defines the cone shown in **Fig. 8**. Light coming in within that cone will be transmitted through the cable; light coming outside that cone will not. The light coming out the far end of a fiber will generally come out in a cone of the same angle, though in some cases the higher-order light modes can be attenuated in a longer fiber, with the result that the light comes out in a narrower cone.

The numerical aperture NA is simply the sine of the angle q, namely

numerical aperture NA = sin q

From **Table 1**, we see that the NA is between 0.2 and 0.3 for most of the fibers shown, corresponding to angles q of 12 to 18 degrees. Multi-mode plastic fiber's NA of 0.5 corresponds to 30 degrees, while single-mode glass fiber has acceptance angles of less than 10 degrees.

The NA is important when matching a fiber to the light source or light detector, or when connecting two fibers together. For example, a plain light bulb would be a very bad light source for a fiber, since its light comes from a large area, most of which would be outside the angle of acceptance.

2m Self-Supporting Delta Loop

So simple—and perfect for apartment dwellers.

Thomas M. Hart AD1B
54 Hermaine Ave.
Dedham MA 02026

While sitting on the couch, reading the newspaper, and listening to some local 2m repeaters on my handie-talkie, I decided my signal needed some additional punch. The handie-talkie with three-inch antenna was not producing anything near the desired "dead full quieting" on certain local machines when it was my turn to comment. Buy an amp? Resurrect that 5/8-wavelength whip? Both of these were unalluring prospects for reasons of cost and ergonomics. My thoughts turned to something different.

Photo A shows a full-wave delta loop for 2m that can be deployed when needed or folded up and stored at other times. The loop is self-supporting, fed with 50-ohm coax, and offers an excellent SWR. The woodworking tools required are simple; tune up is easy; and it travels well. The design is for vertical polarization, the norm on 2m FM work.

The materials for the frame include a 12-inch-wide pine board, two 36-inch dowels of 1/2-inch diameter, a bolt with wing nut, and a spring-loaded clothespin. The wire used in the element is Radio Shack™ hookup wire fed by an SO-239 fitting. An appropriate length of coax is used to connect to the rig.

My only test instrument was a Radio Shack 2m SWR meter. The final tune-up assembly eliminates the traditional "cut, cut, cut, oops—too short" method in favor of a nut and bolt slider. When complete and sitting in the middle of the room, the antenna performs remarkably well. Further, it is less expensive and cumbersome than either of the initially considered alternatives.

Construction was easy (see **Fig. 1**). I cut a 12-inch-diameter circle from the pine board and drilled a hole in the center. Careful filing produced a tight fit for the 36-inch dowel that supports the antenna. A second dowel, 28 inches long, was cut for the horizontal element. Then, it was time to rough cut the wire and start final tuneup.

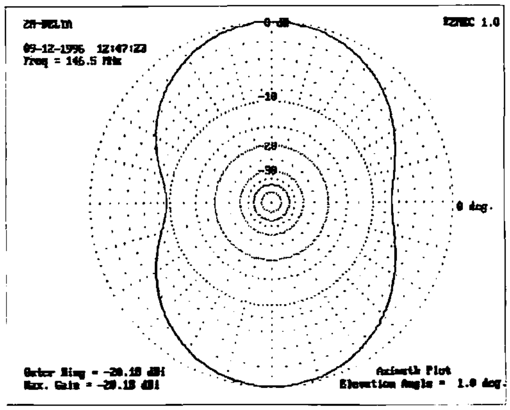


Fig. 2. Software analysis. Azimuth plot of field strength by Eznec software program. Gain is shown perpendicular to plane of loop.

The formula for a loop on high frequency antennas was used as a starting point: Length = 1005/F(MHz) = 1005/146.5 = 6.86 feet of wire.

I cut a seven-foot length of hookup wire and soldered one end to the center connection of the SO-239 connector. A short length of wire with a screw and nut on the end was bolted to the ground side of the socket. This acts as a fine-tuning device.

The loop and frame were then taped together in a rough approximation of the final shape. A period of cutting and SWR measurement brought the loop close to final length. A section of insulation was removed from the end of the loop and final adjustment was made by sliding it through the nut and bolt assembly. When the SWR registered 1:1, I tightened the tuning assembly and used a bolt and wing nut to hold the frame together. Another bolt fastened the SO-239 to the end of the horizontal element, and a spring-loaded clothespin was attached to the vertical dowel to provide strain relief for the coax. The final step was to retune the loop because the SWR changed slightly after the addition of hardware and final shaping.

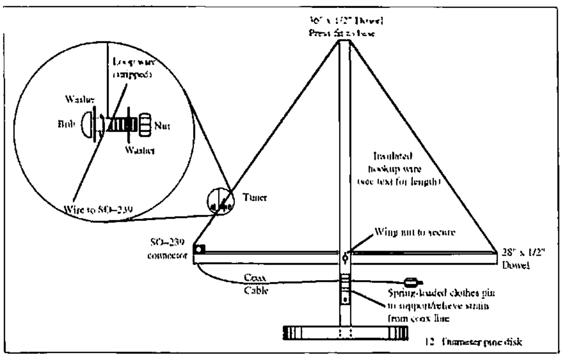


Fig. 1. Construction details.

The loop has worked very nicely for me. I stand it in the middle of the floor and have no trouble working all I can reasonably hear. Recently, it was interesting to pick up a signal from a repeater located on Long Island. By rotating the loop, I was able to bring the signal up to a very reasonable level. I could not work that repeater because the local machine would come on and cover up Long Island. I was impressed by the directivity of a single loop, however. This self-supporting loop has worked very well and is a simple alternative to running higher transmitter power.

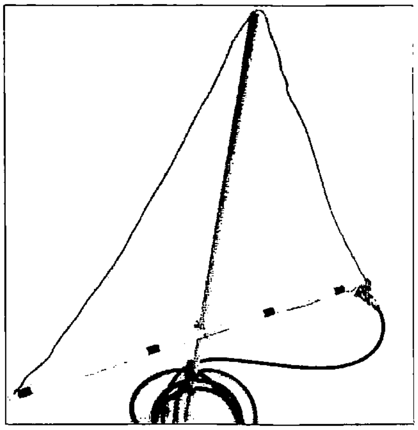


Photo A. 2m self-supporting delta loop.

Home-Brew Transistor/Diode Tester

Not just blinking lights and weird noises.

Henry L. Bowman
Rt. 1, Box A-190
Parsons TN 38363

Although I'm not a radio amateur, I enjoy reading each new issue of *73 Amateur Radio Today*. Unlike other electronic magazines, which offer construction projects with silly blinking lights and weird noises, *73* provides useful projects that are well worth the time and effort to build. I built J. Frank Brumbaugh's Capacity Meter (March 1996) and have found it to be one of my most useful test sets.

I have always needed a better method to identify and test transistors, but I didn't want to invest a lot of money in commercial test equipment. I decided to build my own tester. The test set described here is designed for out-of-circuit testing, uses two ICs (only 1 if you use the dual 556 timer), and can be built in an afternoon. It will automatically identify transistors for NPN or PNP type

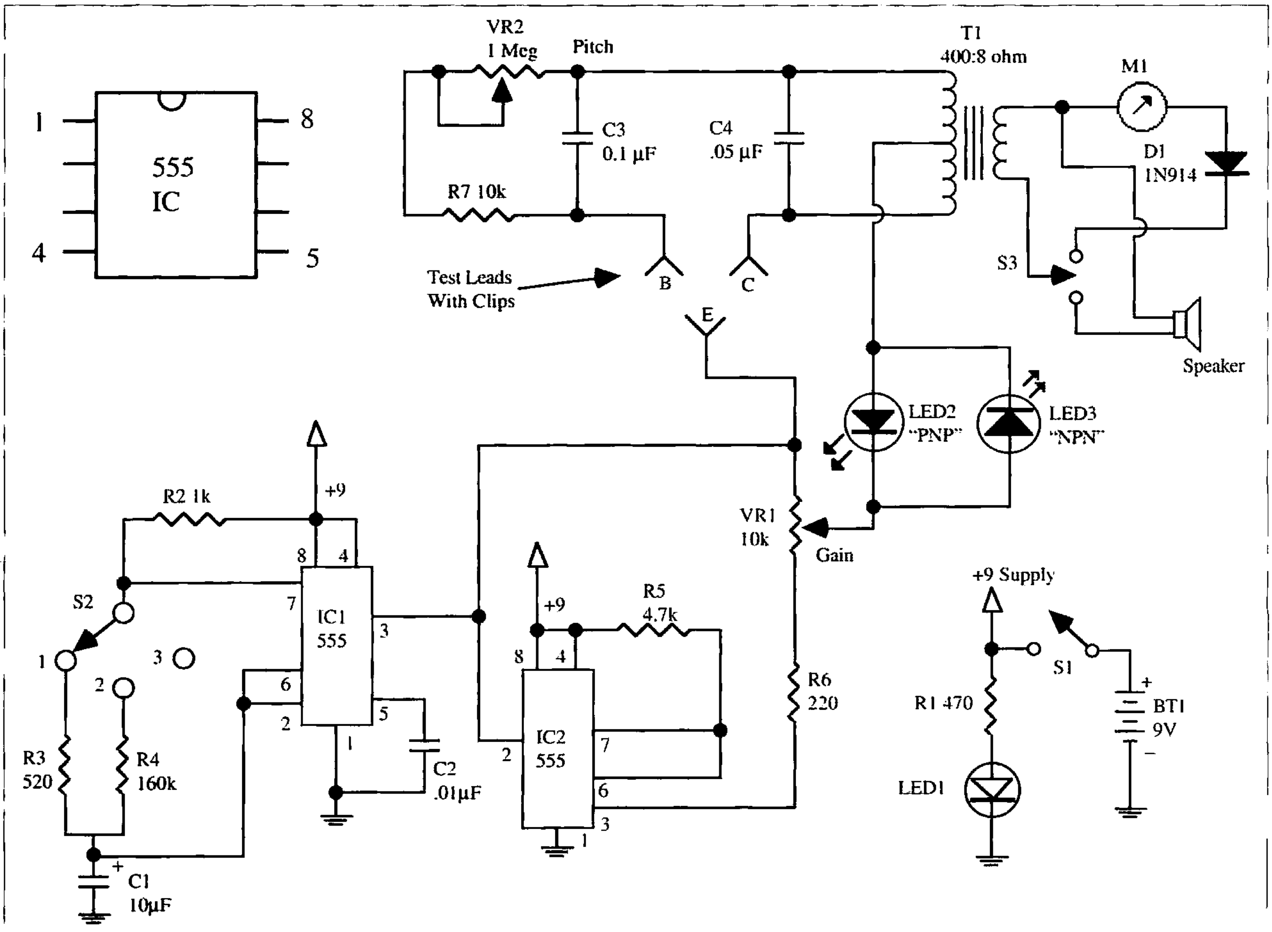


Fig. 1. The transistor/diode test set schematic. S2 positions: (1) diode test; (2) transistor test/identify; (3) freeze last pulse.

as well as give you a relative indication of gain. In audio mode, unmarked transistor leads can be identified. Diodes also can be checked for shorts, opens and polarity.

Circuit description

Fig. 1 provides the schematic diagram of the transistor tester set. IC1 and IC2 are both 555 timers and their outputs are capable of sourcing or sinking up to 150 milliamps of current. IC1 is connected as an astable multivibrator and the output clock rate is dependent upon the values of C1, R2 and the setting of selector switch S2. The output clock from IC1 is connected to the trigger input of IC2 and also connected to one side of variable rheostat VR1. IC2 is wired as an inverter and simply provides a complementary output, of IC1, to the other side of VR1. When the selector switch is in position 1 or 2, the DC voltage on the two 555 timer output pins is continually reversing in polarity and similar to a flip-flop in operation. When the selector switch is moved to position 3, the RC network of IC1 is disconnected so that the last output voltage pulse remains constant.

The wiper arm of VR1 provides an adjustable voltage, in series with LED1 and LED2, to an oscillator circuit, which depends upon the transistor under test for oscillation. If a known good NPN transistor is correctly connected to leads E, B and C and the selector switch is set for position 2, the NPN LED should light for approximately one second, remain off for one second and repeat the cycle. During the pulse period that the LED is lit, the transistor will oscillate as indicated by a tone from the speaker or an output indication on the meter, depending upon the setting of switch S3. If the NPN LED lights on one pulse and the PNP LED lights on the next pulse, then the transistor should be considered faulty. R6 provides current limiting to the LEDs, if a shorted transistor were inserted. VR2 provides tone pitch control and also has an effect on transistor gain.

Circuit construction

I built the circuit on perfboard using two 8-pin wirewrap IC sockets to mount the 555 timers. If a low wattage soldering iron is used, wiring can be soldered directly to the IC pins, eliminating the use of sockets. All resistors, capacitors, transformer T1 and the 9-volt battery were mounted on the perfboard; the remainder of the components were mounted on the faceplate. Parts locations are not critical. For the test set faceplate, I cut out a five- by seven-inch panel from scrap aluminum and drilled out holes for the pots, switches, meter, LEDs and test leads. Four 1/8-inch holes were drilled in the midsection to allow audio from the speaker. The aluminum panel just fit a small metal enclosure I had in my junk box. A plastic cabinet with aluminum faceplate is available from Radio Shack™ and gives any homemade test set a professional look. I used color-coded clip-on test leads for the emitter, base and collector connections. These leads have alligator clips on both ends and are also available from Radio Shack. I cut the clips off at one end and soldered the cut ends to the proper components on the perfboard and faceplate, then installed a rubber grommet in the faceplate hole for the test leads, and then ran all three leads through the same hole. I placed a small nylon cable tie around the test leads on the inner side of the faceplate for strain relief; you may prefer to use a larger faceplate and mount several types of transistor sockets, wired in parallel, to provide test connections.

I salvaged the meter from a discarded stereo amplifier, but any 150-200 microamp meter should work nicely. I have also had good luck with 50 microvolt full-scale meters for audio level use. The 50-microvolt meter is intended to be paralleled with a high-current shunt bar, and telephone companies usually replace these meters when increasing their power distribution capacity. If you know someone who works with telephone switching equipment, they may donate one that was removed from their power boards after an upgrade. If you are unable to locate a 3-position selector switch, you can use an SPDT switch to change the pulse rate, and add an SPST switch in series, between C1 and pins 6 and 2 of IC1, to open the RC network and stop the pulse.

The LED indicators LED2 and LED3 should be capable of 50 milliamps of forward current in case a shorted transistor is connected for testing. If you intend to use LEDs found in your junk box, and are unsure of their current capacity, be sure to use red, instead of yellow or green, because they are usually (but not always) rated for higher current. During normal operation, with a transistor connected for test, the total test set current drain is approximately 30 milliamps.

Testing

After assembly is completed and the test set is connected to a 9-volt battery, place the selector switch in position 2 and turn power switch S1 on. LED1 should light, indicating power has been turned on. Using an analog voltmeter, place the voltmeter leads across the collector and emitter test leads. With the gain potentiometer (VR1) turned fully clockwise (all resistance out), you should see the voltmeter indicate approximately 6 volts for a second, then a polarity reversal during the next second, then the cycle repeated over again. If no voltage is observed, move the voltmeter black lead to ground (negative) and connect the red lead to pin 3 of IC1. If a pulsing voltage is observed, move to pin 3 of IC2 and also check for voltage. Recheck all wiring and replace ICs if necessary. After the problem is located and corrected, return to the collector and emitter test points and recheck for alternating voltage. Change the selector switch S2 to position 3. The voltage should remain constant from the last pulse, and you may have to reverse your meter leads to verify. Change the selector switch S2 to position 1 and verify that collector-emitter voltage drops to approximately 2–3 volts. This is because of the rapid reversals (100 cps) that are occurring; the meter is only providing an average reading.

Operation

Connect a known good NPN- or PNP-type transistor to the three test leads, turn switch S1 to position 2 and turn on the power. The LED indicating the correct transistor type should light for approximately 1-second intervals and the second LED should remain unlit. If switch S3 is in the "audio" position, an audible tone should be heard from the speaker each time the LED lights. To "freeze" the pulse, switch S2 to position 3 just as the LED lights. Adjusting VR2 will change the pitch of the tone and also have an effect on gain. Throw switch S3

Parts List	
IC1, IC2	NE555 IC timer or NTE955M
(2) 8-pin IC socket*	
R1	470Ω 1/2W
R2	1000Ω 1/4W
R3	520Ω 1/4W
R4	160k 1/4W
R5	4.7k 1/4W
R6	220Ω 1/2W
R7	10k 1/4W
VR1	10k variable rheostat linear taper
VR2	1 megohm variable rheostat linear taper
S1	SPST toggle switch
S2	3-position rotary switch
S3	SPDT toggle switch
C1	10μF 16V electrolytic
C2	.01μF disc ceramic
C3	0.1μF disc ceramic
C4	.05μF disc ceramic
T1	Audio transformer 400VCT: 8Ω*
M1	Meter 150-200μA
8Ω mini-type speaker	
LED 1, 2, 3	NTE3007 or equivalent
D1	Diode 1N914
(3) Test leads w/alligator clips	
BT1	9V batttery
Snap-on connector for battery	
Case*	
Perfboard*	
(3) Pointer-type knobs	
* Available at Radio Shack®	

from audio to meter. The meter should indicate an output level when the LED lights. If the meter that you used pegs out with every transistor tested, you may have to install a 50k potentiometer in series with the meter to adjust sensitivity. It would be a good idea to check both NPN- and PNP-type transistors before continuing. To check a diode, simply connect the emitter and collector test leads to the diode and switch S2 to position 1. A good diode will light only 1 LED, while a shorted one will light both. Neither LED will light if the diode is open.

Going further

Experimenting with different types of transistors will quickly get you familiar with the test set. You can rapidly sort transistors for types and discard defective ones found in your junk box. You will be able to identify leads on unmarked transistors because the transistor will only oscillate when properly connected. I noticed that some horizontal output power transistors caused both LEDs to light during testing, even though they would oscillate and provide a good output on the meter. After checking the specifications for these transistors, I found that they were manufactured with an internal damping diode which made the transistor appear to be shorted!

You might want to consider adding a milliammeter in series with the collector test lead to measure the current of the transistor under test. To maintain the correct current polarity to the meter will require installing a bridge rectifier circuit in series with the collector and inserting the milliammeter in the center of the bridge. The bridge diodes will route the current in the same direction through the meter regardless of whether an NPN or PNP transistor is being tested. The diode bridge will cause an additional voltage drop of approximately 1.4 volts and this will affect the gain of the test set. In order to compensate for this, you may want to increase the power supply voltage to 12 volts. The 555 timers can safely handle the voltage increase. Do not use a 12-volt supply unless you intend to add resistance of some type in the collector-emitter test circuitry to compensate. The higher voltage can cause the transistor, under test, to break down with reversed voltage (avalanche current) and both LEDs will light providing a false indication that the transistor is shorted.

Another alternative, to measure current, is to add a 100-ohm resistor in series with the collector lead and use the measured voltage drop across this resistor to calculate the current. For example, if the measured voltage across the resistor is 1.5 volts, then use Ohm's law to determine the current: $I = E/R$ or 1.5 volts/100 ohms = .015 amp or 15 milliamps. The base current can also be calculated by measuring the voltage drop across the 10k resistor R7. The Hfe, or gain, of the transistor can be calculated by the formula $Hfe = Ic/Ib$ where Ic equals collector current and Ib equals base current.

I hope that this transistor/diode test set proves to be a valuable part of your test gear. If you find a modification that enhances it, I'd like to hear from you!

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

Well, about all that comes to mind is that wonderful old song which goes, "Though April showers may come your way / they bring the flowers that bloom in May." While we have had our share of precipitation here in the mid-Atlantic states, blooming here at WA3AJR are your questions, and what questions they are! This month brings a pack of real problems.

I'll start with one from Wayne Grove K9SLQ, who writes that he recently uncovered his Model 28 in the garage, picked up a tape recorder and TU, fired the sucker up and enjoyed the sounds again from the ol' 28. Well, his question is, "Where can I find some of the old PIX we used to send in file form? I combed your articles but could not find any mention of the PIX in the 'Good Ol' Days'."

Well, Wayne, several years ago I ran an entire feature on TTY pictures, some of them quite complicated. In fact, it seems to me that for some years there was a competition on the air to see who could come up with the most creative picture. Some of them were *very* creative, indeed! Unfortunately, with the onslaught of computer terminals, many of which sported a different line length than teleprinters, and few of which could back scroll to view transmitted pictures, it seems to have gone out of vogue. I have asked several times here in the column for submissions, and have received none. So, unless you happen to run across someone with a good collection of old paper tapes, I am afraid that this may well be one area where the computer is just not as much fun as an old mechanical printer.

With the recent demise of AEA, as reported in this column a bit ago, we are beginning to see more unanswered questions about some of their products.

Such a question comes from Chris Cieslak AA9HD, who writes: "I've been using RTTY now since last summer, starting with the HamComm circuit and recently graduating to a used PK-232 bought at the local hamfest. (The first time I used it after replacing a few parts and cleaning it up was the RTTY Roundup—talk about trial by fire!) I have one question: Do you know of any home-brewable scope-style tuning circuits for the PK-232, which has outputs on the back for a scope? The tuning indicator on the front is nice, but I've always liked the cross displayed on a scope. I know I could use an old hamfest scope, but my limited shack space and sense of aesthetics requires something a bit smaller."

Well, Chris, I'm afraid that the short answer is "no." I have seen a few circuits in the past for LED-type display boards, but these were years ago, and relatively clumsy by today's standards. I would not be surprised, though, if some reader of this column has not already put together such a device. If I hear about it, I'll print it for all to benefit.

Another AEA user, Ron Modeste N3AHD, bought an AEA CP-1 at a local hamfest, and is looking for a way to copy RTTY or CW with an IBM-style computer with this device, designed for the C-64. Well, Ron, while I have printed a lot on the CP-1 over the years, never has anyone written with a connection scheme for the PC. Somehow, I feel this is possible, but not having access to a CP-1 nor full documentation, I am loath to suggest a way. If any of our readers have done it, I'm sure we will both hear about it, real soon!

Not satisfied with one question, Chris Cieslak AA9HD adds:

"Oh, OK. One more question. Have you heard anything about using the ICOM 728 for RTTY? I've been using it full power for a while and while it's gotten quite warm, it wasn't hot enough to burn or anything. The manual mentions nothing pro or con on keydown RTTY. *QST* says the radio was barely warm after several minutes of keydown full power, but what about repeated use? I love RTTY and operate it more than anything else (except maybe SSTV) so I'd hate to have to turn the power down."

While I have not heard any specific information about the ICOM 728, in general, most modern rigs should not be run wide open, key down, for any length of time. I hear you about getting only barely warm, but that's on the outside. Who knows how warm it is at the component level? I'd play it a bit safer and back the power down a notch. After all, in the scheme of things it may only be a decibel or so difference on the air, versus a decade or so life of the equipment. I'm open, of course, for comments on this one, as well!

Ford A. Peterson NØOQW writes that he is looking for software to run his HAL Communications ST-6000. He indicates that an old program, HAMRTTY, worked well, whereas the newer Hamcomm program does not compare. He wonders which of the newer crop can use all of the features of the ST-6000.

Well, Ford, my experience with HAL devices ended with the ST-6, I'm afraid. [...Why are you afraid, Dave?] I do recall that the ST-6000 had some gizzies that took it head and shoulders above other demodulators of its time, but although I looked through some of the packages in the RTTY Loop Software Collection, I did not see any which specifically mentioned the ST-6000. I would be interested in any reader's experience with this TU in modern systems.

Of course, things can get *too* modern! A while back we were talking about using various sound cards on RTTY, and Tom Petruzzelli WA2ANG is "still looking for any programs that use the Soundblaster card for sending or receiving RTTY and/ or CW. Do you know of any software either commercial, freeware or shareware?"

Well, Tom, while I was not able to find any RTTY program for the Soundblaster card, I have located a program called SSTVBL.ZIP, which allows slow scan television with a computer, Quick-Cam camera, and Soundblaster card. I've also found a program called SBPMORSE.ZIP which is a Morse code reader using the microphone input of the Soundblaster card. I don't know if these will run with "compatible" sound cards, as they both list the Soundblaster by name as the audio card of choice. I will be putting both of these programs onto a disk in the RTTY Loop Software Collection. See details below for how you can obtain any or all of these programs for yourself.

While some of the folks mentioned above have been trying to get C-64 hardware, like the CP-1, to run with PCs, Jerry Olson WBØAAC says that he is looking for software to interface his Commodore C-64 computer with the Kantronics UTU demodulator, for running RTTY, AMTOR, or CW. Again, I can't see why it shouldn't work, if the connections can be put together. Anybody?

I have mentioned the RTTY Loop Software Collection above. The listing of this collection, over fifteen disks of RTTY programs for DOS and Windows operating systems, is detailed on the RTTY Loop Home Page, on the Web at: http://www2.ari.net/ajr/rtty/ or you may obtain it by sending a self-addressed, stamped envelope to the above address. Next month, I have a new offering from overseas, which represents a unique merger of two ends of this crazy hobby. Intrigued? Don't miss next month's RTTY Loop! 73

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119
[clhough@aol.com]

Modifications to the MFJ-259/219 SWR Analyzers

I just hate to turn on a piece of test equipment and find the batteries dead. I would rather have the batteries discharged and recharge them than have to purchase a replacement set of alkaline batteries. Considering the current price for alkalines and the cost of NiCds, the latter become very attractive—especially after you purchase your second set of the former. The trick here, though, is that the battery connector on the MFJ-259 SWR analyzer is for an external battery. When an external battery is connected, it disconnects the internal alkaline pack.

I had to modify this operation so that I could use external batteries if I wanted to, as well as charge an internal NiCd pack. These modifications were to be made in such a manner that the MFJ-259 was protected from reverse voltage and its basic operation not affected. The problem here was that the original connector, when hooked to an external battery, cut off the ground connection to the original internal battery pack. When installing NiCds, avoid this by shunting around the switch with the current-limiting resistor.

Several cautionary notes need to be observed when making a modification like this. The paramount thing is to make the external connection *idiotproof*. Make the modification impervious to reverse-connected DC power. Wrong polarity connected, nothing happens—a great insurance policy that provides a great deal of protection for the cost of a small diode rectifier like a 1N4002.

The last thing you would want is to connect power and destroy this SWR meter. My garage is littered with carcasses of car stereos and other toys that were rewired for little experiments, only to be subjected to momentary loss of sanity (polarity) and quick destruction. If you do something like this modification, please take the time to do it right. The modification has to account for (1) reversed polarity; (2) supplying a trickle charge to the NiCds instead of a fast one; and (3) retaining the original external power connection to keep the unit's original appearance. See **Fig. 1** for the original power connections circuit and how it was modified with internal NiCds to accommodate the new charging options.

I have oriented the PC board to show the unit face down and with the back cover removed. I placed the UHF connector up, or at 12 o'clock. Note the connector for external power and its three solder tabs. The top connector is common board ground, the one at lower right is switched to ground (internal to the power connector socket), and the bottom left one is the center connector or +DC voltage. The +DC connection also has a wide trace going to the on/off switch center connector. This trace will be cut and replaced with a rectifier diode for polarity protection.

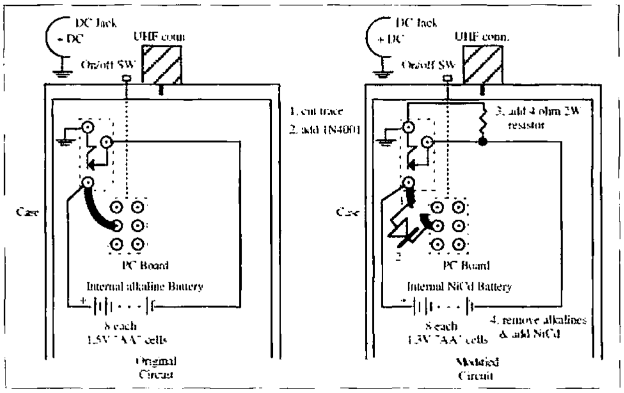


Fig. 1. PC board prior to modifications, and after modifications with DC polarity protection and NiCd 4-ohm current-limiting resistor added.

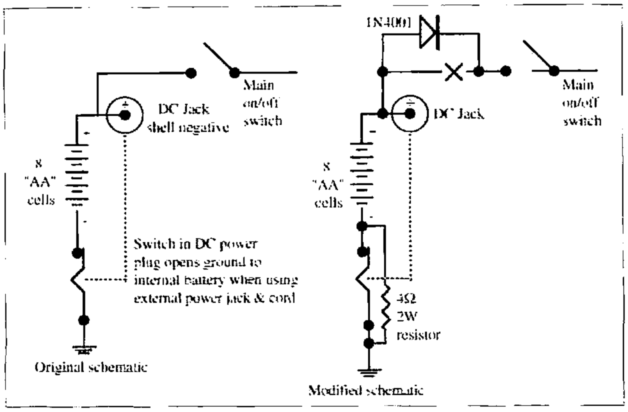


Fig. 2. Basic input electrical schematic circuit of original and modified circuit for NiCds and current-limiting and diode-protection circuit.

This diode will not protect the NiCds from reverse charging, but will protect the electronic circuitry of the MFJ SWR meter. To protect the NiCds from reverse charging, add another rectifier diode in series with the 4-ohm resistor connecting diode cathode to ground. Current-limiting is done by the 4-ohm 2-watt resistor that ties the ground and switched ground together as shown in **Fig. 2**.

Consult **Fig. 2** for a brief schematic of the standard circuit before and after modification. You can use this as a guide to "ohmmeter out" the exact points of modification from the power connector to sort of test it prior to modification—just to be sure you and I are talking about the same connections and don't have any misunderstanding.

I have to tell you that operation with NiCds (8 each) will produce about 10 volts. The protection diode will drop that voltage to 9.3 volts for feeding the meter circuits. This is sufficient to operate the meter, but if you are a purist there is a more sophisticated meter polarity circuit that you can install. Normally this circuit is reserved for situations that can't withstand a protection diode and its associated voltage drop.

The no-voltage-drop circuit is accomplished by adding to the original circuit a diode and DC relay. The diode is connected in series with the DC-relay main coil. This circuit (diode and relay coil) is connected between the main DC power input and ground, with the main DC power to the circuits it is going to protect passing through normally-open relay contacts.

When correct polarity is applied, the relay operates and its contacts close, applying the correct-polarity DC through to the circuit being protected. What happens if reversed-polarity DC is connected to this same protection circuit? The diode in series with the relay coil will not allow reversed current to flow to operate the relay coil. It will prevent the reversed battery from operating the relay coil and save the equipment from possible destruction. See **Fig. 3** for details.

Do not test this circuit and mechanically operate this relay, as you will destroy the circuit you are trying to protect. Let the DC voltage operate the relay when the polarity is proper. Remember, the protection circuit can be overcome by manual intervention if someone pushes the relay and closes its contacts. Just don't try to force its operation.

These modifications are quite simple—but don't rush into the project thinking it's a cinch. Take care even when doing an easy project, and don't be overconfident. That's when simple projects can become easy miscalculations. Think it out and verify everything with an ohmmeter to be sure of just what you are doing. And be aware that *any* modification might void your warranty on a new unit.

I constructed my 4-ohm 2-watt resistors out of two 2-ohm units; wrapped them in heat shrink to insulate them; and then formed the leads and soldered them to the PC board.

The DC power trace feeding the on/off switch was cut in mid-trace position with an X-Acto™ knife. The protect diode is installed with the cathode end towards the on/off switch. Any suitable diode or resistor combination will do the job here, and values or exact parts are not necessary.

The MFJ meter will function as originally intended with the exception that it now has internal NiCd batteries that can be charged from the external connector. The meter can be operated from either the internal NiCd batteries or the external (charging) DC power cable. (Note: The batteries will always be under charge through the 4-ohm limiting resistor in the NiCd battery ground circuit when using the external power option.)

After the modification is complete, the meter can be used with either power feed option, internal or external, and retain its original feel and appearance. I have used my meter with this modification for about 6 months and find it to be very good. I have left the power switch on, or it got bumped on, and I did not notice it. The benefit now is that whenever I pull it out for use I don't have to worry whether the internal batteries are ready to go. If they aren't, I stick it on a bench charger for a fast charge cycle and it's ready for use in less than half an hour.

Of course, NiCds being what they are, I don't get a lot of capacity time in a half hour charge (although it usually is sufficient). With a little planning the night before, you can charge it up overnight, saving the cost of a new set of alkaline batteries.

The MFJ-219 450-MHz SWR analyzer

While the MFJ-259 will work the full frequency spectrum from 2 MHz to just over 170 MHz, what can be done for 1-1/4 meters (450 MHz)? Well, they also make an SWR meter (the MFJ-219) with internal generator for the 450-MHz frequencies. I picked one up, tried it on the 432-MHz antenna project, and am happy to report it works just fine. And while this meter is touted to operate from 420 to 450 MHz, I discovered it has a few other extra benefits.

I found the 219's frequency readout scale to be inaccurate outside the amateur bands markings. Using the calibration markers to their extreme, I found that the unit I have will function from 410 MHz to slightly over 465 MHz. This allows measurements in the commercial portion of the 450 MHz frequencies to nearly 470 MHz. I suspect it could be coaxed up there, if that is your interest, by a slight tweak of the oscillator coil. To know what frequency the meter is set at, use the external frequency meter connector and get a direct readout.

This unit is quite a bit smaller than the VHF (259) one and the circuitry is quite dense. There is just about enough room for the two alkaline 9-volt transistor batteries. If I were to make a similar NiCd modification to this MFJ-219 unit, the 9-volt variety would still have to be retained even though there is not much time-to-current capacity in this type of battery. The bottom line is that there is no room for a larger battery. The electronics package takes up most of the case interior and thus this unit will stay unconverted for the time being. I am shopping for 9-volt NiCd bargains and will modify the unit when they are picked up.

The alkaline variety of 9-volt batteries will give good performance, but due to their cost and limited mAH capabilities, you think twice about leaving this unit on for extended periods of time. To conserve the 9-volt batteries, I recommend you make your test and then turn the power off until the next one. Life is not all that bad, as I left the battery switch on for a half hour while transporting the unit from a field trip and still had battery life to operate it. It's just that I am now on the verge of purchasing a replacement set of new 9-volt alkaline batteries, and that tugs on the wallet.

My recommendation here, due to the limited size, is to keep the alkaline batteries and get an external power connector and 12-volt rechargeable battery to use for extended test sessions. For you purists out there, the dial calibration in the amateur segment is quite good for reference use. However, for band-edge operation you might be well advised to attach an external frequency meter to the sample port for accurate frequency readings. Operation with the external frequency meter removes all doubt as to your exact frequency.

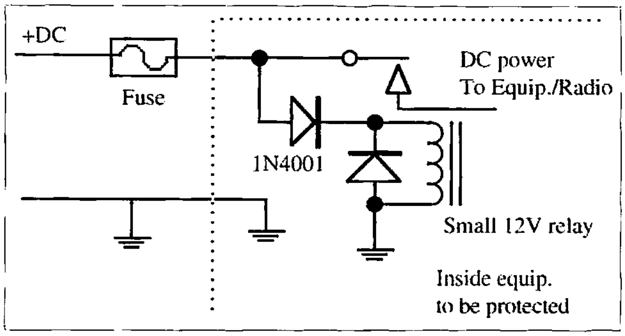


Fig. 3. Alternate no-voltage-drop reversed-voltage-protection circuit using a DC relay and a small diode rectifier. Relay will not operate unless the polarity is positive on the input lead, which then closes the relay contacts. Select a relay with contacts that will carry the amperage of the unit you are trying to protect.

There are several adjuncts that can prove to be very useful with the MFJ-259 SWR analyzer. This little self-contained unit intended for aligning antennas can be put to use in many other applications, making it very versatile.

Both the 259 and the 219 can be used as a general-purpose bench signal generators to adjust circuits within their respective frequency ranges. Such a unit is not suitable for SSB narrowband receiver tests, but it can be a great help for workbench circuit testing when you connect it to a simple resistor attenuator diode detector arrangement. Testing resonant circuits like cavities and other bandpass circuits is quite easy. The SWR analyzer is not a tool that is used every day, but when it is needed for antenna analysis or other tasks, both of these units work well. Here is a brief rundown on the two SWR analyzers.

The MFJ-259 HF/VHF unit is capable of operation from 1.8 MHz to 174 MHz in a six-band step arrangement. The output of the signal generator is nearly 200 mW. The high power output can be quite useful in adjusting circuits that need to be attenuated, such as cavities that are out of resonance. The power output can be adjusted with an external resistor step attenuator as you get near resonance and lower loss. Used together with the internal frequency readout indicator, this makes for a very powerful bench signal generator.

As with all basic units, there is always something more that can be added to a device to make it more useful. The analyzer as it comes from the factory is quite a powerful tool that is usable with ease to adjust antennas in its frequency range. One more stock feature might make this unit really shine. It would be to add a protective case to allow outdoor use without subjecting the analyzer to rough handling and perhaps accidental jarring. The MFJ-29 case, available separately, is not expensive ($20) and affords the meter a good deal of protection. I found a small Tektronics pocket o-scope case at our local swapmeet (for a buck) to protect the meter, and it works well.

The MFJ-219 UHF SWR analyzer doesn't need a carrying case, as it is more robust than the more delicate 259 meter with its LCD display to protect. I provided a case for my unit, as I don't want it to get tossed around. After all, it's still a precision instrument that needs protection if you expect to make reasonable test results. I am on the lookout for a single carrying case for both units and their accessories, and have been looking at the feasibility of some small computer laptop case for this purpose. There are a lot of surplus laptop computer cases on the market for very reasonable prices, so we will see what turns up. 73, Chuck WB6IGP.

Number 76 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Color me video!

For the past few months, we've been exploring the development of television, and the makeup of video signals. This time, let's take a close look at the color, or "chroma," signal.

As I mentioned last time, it was decided that the color information could be separate from the brightness, or "luminence," portion of the picture, and could be hidden on a subcarrier riding on the baseband video itself. (By "baseband," I mean the actual video signal, rather than the radio signal coming from a transmitter.) We took a look at the basic scheme: a high-frequency signal, non-harmonic with the line scanning rate, simply added to the video signal. But how do you get that one signal to represent the two essential color elements of hue and saturation?

Matrix!

If you're familiar with FM stereo broadcasting (which came much later, but that's irrelevant here), you know how two signals can be added and subtracted from each other algebraically. Hmmm, let's take a quick detour and go over it; the concept is crucial to understanding color video signals.

To add two signals, you feed them through resistors which meet at a common point. To subtract them, you invert one first (turn it upside down), and then do the same thing. The resulting voltage at the common point will represent the combination of the two signals, either an addition or a subtraction, depending on whether one of the signals was inverted. And, of course, that voltage will move up and down as the signals change.

In stereo audio, there are two items to represent: left and right. So, you can create two matrixed signals: L+R and L-R. FM stereo sends the L+R signal (which is simply a mono mix of the two channels) on the main carrier, and sends the L-R signal on a subcarrier. That way, a mono receiver will hear a normal mono signal, while ignoring the L-R subcarrier. The stereo receiver, though, will detect the carrier, recover the L-R signal, and then mix it twice with the L+R signal. Twice? Yes—one mix will be an addition, which will produce (L+R) + (L-R), which equals 2L + 0R, or simply 2L. The other mix will be a subtraction (by inverting one of the signals first), which will produce (L+R) - (L-R), or 0L + 2R, or simply 2R. Thus, the L and R signals are recovered. Pretty slick, huh?

Color TV used the same idea, but it was a little bit more complicated. Since there were three colors to represent (red, green and blue), the matrix consisted of three elements. Sending three elements on one subcarrier, though, would have been rather tricky, as it would have required sequential timing circuits, tough to implement with the vacuum tube technology of the day. Sending two, though, wasn't overly hard, as any AC wave (such as the subcarrier) has two polarities, positive and negative, which can be used to represent two elements of information, and then be separated at the receiver. Was there a way to reduce the matrix to two elements and still recover all three colors?

Ta da!

In this case, yes. Luckily, the luminence signal was there, too, and could be used as part of the equation. Let's see how they did it:

The luminence signal, called "Y" (Y call it that?—I don't know), was used as a reference. It, of course, was just an addition of R, G and B. By subtracting Y from each individual color signal, R-Y, G-Y and B-Y were produced. Then, the G-Y signal was simply discarded! What?? How could they ever recover the green information if they threw G-Y away?

In order to grasp the recovery of the green signal, it's important to keep the relationship of Y to the chroma signals in mind. Remember, the Y signal is a combination of all three original, pre-matrixed red, green and blue signals. So, if you recover the R-Y and B-Y signals (we'll get to how they did that, in a moment), and then add Y to each of them, you've got the R and B signals back. Now, add those together and subtract the result from Y, and what's left is the amount of G that was in the Y signal. In other words, green, which was hiding in there all along! This is a classic, if convoluted, case of solving for one missing variable when the other two are known. It's detective work, more or less.

> **"Sending three elements on one subcarrier would have been tricky with the vacuum tube technology of the day."**

Ride 'em, subcarrier

Since Y would be available at the other end of the process, this crazy thing could actually work—but the problem of how to encode R-Y and B-Y onto one subcarrier remained.

Remember when I mentioned that you could use the two polarities of the subcarrier independently? Well, why not? What if you used the amplitude of the negative peaks, say, for the B-Y signal and the amplitude of the positive peaks for the R-Y? Would that work? It sure would! (Actually, I don't remember which peak was used for which, and my video reference books are all packed away. But it doesn't matter; the principle is the same.)

OK, it was in there, but how the heck could you recover that information? With a normal, symmetrical AC waveform, the center, or zero-crossing, line is easy to find. But this thing would be riding along on top of the Y signal, so its center line would be wandering all over the place! Simple amplitude detection of the positive and negative peaks wouldn't work.

Synchronize your crystals!

The answer lay in synchronous detection. That's just a fancy way of saying that the receiver regenerates the equivalent of an unmodulated subcarrier, and then compares it to the real one. The unmodulated one tells the receiver when the positive and negative peaks should occur, letting it examine each polarity separately. In other words, time, rather than amplitude, is used to find the occurrence of the two polarities.

How to do that? Luckily, quartz crystals are pretty stable. If you synchronize a crystal oscillator to a reference signal, and then remove the reference, the oscillator will stay in "blind sync" with the reference for a short period of time before drifting off into never-never land. You'd never get away with that sort of thing using an LC oscillator, but it works with a crystal. Of course, a "short period" is a subjective quantity. Luckily for color TV, that time period only needed to be 62.5 microseconds, or the length of one horizontal line.

So, a reference signal was placed at the very end of each horizontal sync pulse. Called the "colorburst," it consisted of about seven cycles of the unmodulated color subcarrier frequency. It was easy enough to create a "burst gate" circuit which let *only* that signal pass, since the horizontal sync could be used to trigger the gate. The reference burst could then be used to sync the crystal oscillator, with new color sync occurring at the start of each horizontal line, right after the horizontal sync pulse, and before any picture information would be displayed.

Using the phase-locked crystal oscillator as a time reference, the synchronous detector could extract the values of R-Y and B-Y encoded on the opposite peaks of the subcarrier. All it had to do was examine the voltage value of the subcarrier when the reference was in, say, the positive state, and assign that to R-Y, and then do the same when the reference was in the negative state, and assign that to B-Y. Thus, the two signals were split off and recovered, and then sent to

the matrices that recovered green and finally outputted R, G and B! All that was left was amplifying them, sending them to the picture tube's electron guns, and enjoying the resulting color picture.

Whew!

I realize that was pretty complicated—it might pay to read it over a few times and let it sink in. Basically, it was all a clever matrixing scheme, designed to fit a color picture into nearly the same bandwidth as a monochrome one. And it worked!

Almost perfect

There was one little anomaly, though, and we live with it today. Although the colorburst signal did provide a reference for the synchronous detector, it didn't say anything about how accurately the transmitted color values represented the picture. And, unfortunately, various TV stations and networks weren't too uniform about that. Plus, phase shifts in the TV's circuits could throw the process off even further. So, even though the TV set might seem to be working perfectly, sometimes the color was off. Enter the hue control.

By varying the phase of the synchronous detector's reference (from the crystal oscillator), values intended for one color could be made to appear in another color, because the detector would be looking at the wrong part of the waveform, due to the time difference. As the phase was continuously varied, the hue of the picture would shift. The hue control, which shifted the reference oscillator's phase, could be manually adjusted to get everything in line for the best perceived picture. By the way, some other TV systems, in use in other parts of the world, have reference signals that eliminate the need for a hue control. Oh well, that's the price we paid for being first in color TV.

The upshot of all this color encoding is that color signals are very time-sensitive. So what? Well, it all works fine for live broadcasting, but it played havoc with the development of color video recording. Next time, we'll begin exploring the recording of TV signals. It's a fascinating topic in and of itself. Until then, 73 de KB1UM.

Number 77 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, **Barter 'n' Buy,** costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't tell a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the August 1997 classified ad section is June 5th, 1997.

TOWER 100' guyed 2' triangular, 10' sections, MIL/AB-105C, ExHD Galvanizing. Dismantled, ready to go. Includes 1/4" guy wire, screw anchors. Excellent condition. Details Phone/FAX, **Jim W9GLR**, Polk City FL. (941) 984-1317. BNB1600

LARGE ASSORTMENT of used test equipment. Most instruments are priced at 10% of original cost or less. Request list. **Jim Stevenson**, 3401 Sunny Slope Road, Bridgewater NJ 08807; (908) 722-6157, **FAX**: (908) 722-6391. BNB2084

ASTRON power supply, brand-new w/ warranty. RS20M $99, RS35M $145, RS50M $209. Call for other models. **(818) 286-0118.** BNB411

The **PHDARA Hamfest** 3 May 8-4PM at the KC Market Center. **Bob WAØCLR (816) 436-0069**, wa0clr@juno.com or Box 28954, Kansas City MO 64188-8954. BNB205

WANTED: G-VG+ cond older mobiles/ hts:IC22A/S/U, 33U, 1C2/3/4A/AT, 13-509/76ers, most any non-mem synth rigs. Also xtals + assys for above. **Mark Whiteman N7TRZ**, NE 114 Ave., Portland OR 97220-2245, 503-257-3820. BNB203

Audio Equipment wanted, 1930s-1960s. Tube-type amplifiers, large or small speakers, mixers, microphones, tubes, parts, etc. Especially Western Electric, Jensen, Marantz, Macintosh, JBL, etc. **1-800-251-5454.** BNB202

MAHLON LOOMIS, INVENTOR OF RADIO; by Thomas Appleby. (© 1967). Second printing available from **JOHAN K.V. SVANHOLM N3RF**, SVANHOLM RESEARCH LABORATORIES, P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. BNB420

BREAK THE CODE BARRIER: A self-hypnosis tape that allows you to learn or increase code speed easily and quickly. To order send $14.95 + $3.00 S&H to **Dr. Hal Goodman**, P.O. Box 184, Eastport, ME 04631. For more info. send SASE or [http://www .nemaine.com/w3uwh/morse.htm] BNB2031

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone:** (616) 925-5899, 8-4 ET. BNB964

CLASSIC RADIOS RadioFinder Web list revised weekly: [www.radiofinder.com] TEL/FAX **(313) 454-1890** [finder @radiofinder.com]. BNB700

DSS BIBLE Volume 2. All new information - No duplication from Volume I. 200+ pages, 280+ files, $79.95 + $5.50 P+H. **DSS BIBLE Volume 1.** - $49.95 PPD. **DSS SECRETS** - All Patents $69.95. All $179.95.VISA/MC **TELECODE**1-520-726-2833. [http:// www. hackerscatalog.com] BNB1024

PRINTED CIRCUIT BOARDS for amateur radio and hobby projects. [hhh:// www.cl.ais.net/larcir] or **SASE FAR CIRCUITS** 18N640 Field Ct., Dundee IL 60118, (847) 836-9148. BNB5013

RF TRANSISTOR TUBES 2SC2879, 2SC1971, 2SC1972, MRF247, MRF455, MB8719, 2SC1307, 2SC2029, MRF454, 2SC3133, 4CX250B, 12DQ6, 6KG6A, etc. **WESTGATE**, 1-800-213-4563. BNB6000

NEVER SAY DIE

Continued from page 55

me with a lifetime of adventure and, apparently, no excitement or adventure for you. Oh, I've tried to get you interested in our ham satellites. I failed. I've tried to get you on slow scan. Failed again. I've tried to get you up to 10 GHz, where I worked seven states. No sale. I've talked up DXpeditioning. Even mini-DXpeditioning to the Caribbean or some nearby spot like St. Pierre. Another blank.

And when I write about the fun I've had doing the above I get carping crapola about my ego. I haven't suggested doing anything I haven't done. And I'm just a guy who's been dumb enough to make his hobby his life's work. Hey, what could be more fun? But when I suggest that you consider getting out of the rat race of working for someone else and experiencing the freedom of having your own business, you just sink lower into your commuting rut and yawn. Get some smelling salts or a bottle of ammonia and come out of that hypnotic trance you've been in for the last few years.

Grumble.

Hey! Wake Up!

What is it going to take to blast you out of that rut you're in?

Rut? Me? Yes, you! If you are working for someone else—if you are commuting to work every day—if you are sick—if you aren't an exciting and interesting person. I've been-there-done-that.

When I was a kid I commuted to high school, an hour trip on the jam-packed New York subway every morning and afternoon. Then there was the time a few years later when I was an engineer at Airborne Instrument Laboratories in Mineola and commuted an hour each way from Brooklyn. I tried it via the subway and the Long Island Railroad, and I tried it driving the Belt Parkway and the Grand Central Parkway. Both ways sucked. But then I was in as deep hypnosis as you and didn't know any better. Yet.

I've been through the hiring and firing routines, complete with résumés and interviews.

Continued on page 81

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the September issue, we should receive it by June 1. Provide a clear, concise summary of the essential details about your Special Event.

MAY 2 & 3

KINGSBURG, CA The Fresno ARC. Inc., will host its annual Hamfest at Riverland RV Park, 3 miles south of the town of Kingsburg, on Freeway 99. The hamfest will be held 7 AM–4 PM, Sat., May 3rd. Hams begin to arrive at the park on Fri. May 2nd, with plenty of RV parking available. Displays of new and vintage radio equip. and swap tables loaded with used radio equipment for sale or trade will be featured. VE exams for all classes. Information will be exchanged on new radio operations, new radio equipment, and operator techniques to improve work in disaster and emergency services. Contact *Fresno ARC, Inc., P.O. Box 783, Fresno CA 93712.*

MAY 3

CADILLAC, MI The Wexaukee ARC will hold their annual Hamfest, 8 AM–2 PM, at the Cadillac Middle School. VE exams for all classes at 1 PM. Adm. $5; 8' table $6. Setup at 6 AM for table holders only. Talk-in on 146.98 rptr. Contact Dan *KE8KU, Wexaukee ARC, P.O. Box 163, Cadillac MI 49601. Tel. (616) 775-0998.*

KANSAS CITY, MO The PHDARA will hold its annual Hamfest 8 AM–4 PM at the Kansas City Market Center, I-435 and Front St., south of Worlds of Fun. Vendor tables $40/ $20, flea market tables $10, radio club tables, call for price. Adm. $6 advanced, $7 at the door. Contact *Bob Roske WAØCLR, Box 28954, Kansas City MO 64188-8954. Tel. (816) 436-0069; E-mail [waØclr@juno.com].*

MAY 3 & 4

ABILENE, TX Abilene will again be the site for the ARRL West Texas Section Convention and the Key City ARC Hamfest. Prearranged setup for dealers and manufacturers on Fri., May 2nd, 4 PM–9 PM. Setup for all others, including dealers arriving late, will begin at 6 AM, Sat., May 3rd. For info and reservations, call *Peg Richard KA4UPA, (915) 672-8889* (leave a message, your call will be returned); or E-mail *[jimr@swconnect.net]*. Find more info on the Web site at *[http://www.acu.edu/~cummingsg/kcarc.html].*

MAY 4

BLOOMINGTON, IN The Amateur Radio Go Getters will host their 3rd Annual AA9HI Hamfest at Monroe County Fairgrounds, 8 AM–3 PM. Setup Sun., 5 AM–8 AM. VE exams reg. at 11 AM, testing starts at 11:30 AM. Inside vendors: $5 per table, $5 per elec. hookup, $5 per ticket. Outside vendors: $5 per flea market space, $5 per ticket. Talk-in on K9TC rptr. 146.895(-) MHz (Tim Crafton K9TC). Contact *John Anderson AA9HI, (812) 332-3734 after 5 PM;* or *Randy Kinser KF9NA, (812) 332-3588 after 7:30 PM.*

HAGERSTOWN, MD The Antietam Radio Assn. will present the 5th Great Hagerstown Hamfest and Computer Show at the Hagerstown Jr. College, Athletic, Rec. and Community Center. Talk-in on 146.940(-) and 146.520 simplex, the night before and the day of the event. Adm. $5, children under 12 admitted free. Write to *Antietam Radio Assn., Inc., P.O. Box 52, Hagerstown MD 21741.*

WRIGHTSTOWN, PA The 23rd Annual Hamfest of the Warminster ARC will be held at the Middletown Grange fairgrounds, Penns Park Rd., starting at 7 AM. Setup at 6 AM. 8' tables $12 ea., pre-reg. recommended. Unlimited outdoor tailgating spaces $9 ea. Computer hardware and software vendors are invited to participate. Adm. $6, unlicensed spouses and children under 12 free. VE exams at 11 AM; reg. at 10:30 AM. Applicants bring original and copy of present license and/or certificates of successful completion, two forms of ID and the $6.25 examination fee (Novice class free). Talk-in on 147.09/.69 rptr. and 146.52 simplex. Contact *John D'Onofrio, 1255 Manor Dr., Warminster PA 18974-2102. Tel. (215) 675-9165, 9 AM–9 PM. E-mail [warc@crompton.com].*

YONKERS, NY The Metro 70cm Network will host a Giant Electronic Flea Market at Lincoln H.S., Kneeland Ave., 9 AM–3 PM, rain or shine. Indoor flea market only. 1st table, $19; each additional table $15, or bring your own tables at $14 for a 6' space. At the door, $25 each table, $20 ea. 6' space. Full payment due with reg. Adm. $6, kids under 12 free. Setup at 7 AM. For reg., contact *Otto Supliski WB2SLQ, 53 Hayward St., Yonkers NY 10704. Tel. (914) 969-1053.* Talk-in on 449.425 MHz PL 156.7, 223.760 MHz PL 67.0, 146.910 Hz, and 443.350 MHz PL 156.7.

MAY 8 & 22

FORT WORTH, TX The Lockheed ARC and the Kilocycle Club will sponsor VE exams for all classes at the Lockheed Rec. Area Facility, 2400 Bryant Irvin Rd., at 7 PM. For details, call *Ted Richard AB5QU, (817) 293-6745.* GROL testing done by appointment only.

MAY 10

GREENVILLE, SC A hamfest will be sponsored by the Blue Ridge ARS, 8 AM-5 PM, at the Anderson County Fairgrounds, E of Anderson on Hwy. 29 Business. Flea market, Buck Rogers, K4ABT SEDAN packet conference, VE exams at noon, overnight camping, free parking. Talk-in on 146.01/.61. Advance adm. $4; $5 at the door. Contact *Gene WB4ZBZ,* or *David KE4QQQ, (864) 476-2609, E-mail: [ke4qqq@innova.net].*

HURON, SD The Huron ARC will sponsor their 4th Annual Amateur Electronics Swapfest 8 AM–3 PM at the Nat'l. Guard Armory, SD State Fairgrounds. Flea market setup 7 AM, VE exams 9 AM. Talk-in on 147.09(+). Contact *Lloyd Timperley WBØULX, P.O. Box 205, Huron SD 57350. Tel. (605) 352-7896 eves.*

MEDINA, OH The Medina County Hamfest will be held at the Medina Country Community Center, 735 Rt. 42. VE exams at 9 AM. Tables $6, outdoor space $4, entrance $4 donation, $3 advance. Talk-in and directions on 147.03 rptr. For more details, contact *Medina Hamfest, P.O. Box 452, Medina OH 44258.*

MAY 15–18

DAYTON, OH The "Four Days In May"© QRP Symposium on Thursday, May 15th, held in conjunction with the Dayton hamvention©, will kick off QRP activities at Dayton. Full day of activities on Thursday at the Days Inn Dayton South (513-847-8422); includes multimedia QRP presentations, catered lunch, door prizes, tech talks, tutorials by clubs. Thursday registration $30 before May 1, $35 after (if still available). Make checks *payable to "Bob Follett" and send to: Bob Follett AB7ST, 2861 Estates Dr., Park City UT 84060, E-mail: [bfollett@ditell.com].* On Fri., May 16th, the QRP-ARCI Awards Banquet will be hosted by FDIM Banquet Chairperson Pete Meier WK8S. Please send $15 banquet ticket fee (US check, MO, internat'l MO) *made out to "Pete Meier"* by May 1st. Mail to *Pete Meier WK8S, 4181 Rural, Waterford MI 48329;* or *E-mail [pmeier@tir.com].* Also on the 16th, Preston Douglas WJ2V will host the FDIM QRP Vendor Evening Social. To register, contact *Preston Douglas WJ2V, QRP Vendor Evening Chairperson, 216 Harbor View N., Lawrence NY 11559,* or via *E-mail: [pdouglas12@aol.com].*

MAY 16

DAYTON, OH The southwest Ohio Chapter of the Quarter Century Wireless Assn. will hold its 1997 Annual Banquet in conjunction with the Dayton Hamvention. Alex's Continental Restaurant, 125 Monarch Lane, is the location for a C.O.D. bar at 7 PM, and a banquet at 7:30 PM. Reservation deadline is May 14th. QCWA membership is not a requirement for attendance. Tickets are $15 ea.; make check payable to *Robert L. Dingle, Treas., Chapter 9,* and mail to *1117 Big Hill Rd., Kettering OH 45429-1201.* Charles Stinger W8GFA, former mgr. of Voice of America Radio Station at Bethany OH, will give an inside look at this powerful transmitting station.

MAY 16, 17, 18

DAYTON, OH The Dayton Hamvention, sponsored by the Dayton ARA, Inc., will be held at the Hara Arena. Fri., May 16th: Flea Market open and bus service avail., 8 AM–

6 PM; Exhibits, Noon–6 PM; Forums 1 PM–5 PM. Sat., May 16th: Flea Market and bus service 7 AM–5 PM; Exhibits 8 AM–5 PM; Forums, VE Exams, Activities, 9 AM–5 PM; Hamvention Banquet at the downtown Dayton Convention Center, 6 PM. Sun., May 17th: Flea Market 7 AM–4 PM; Bus service available 7 AM–5 PM; Exhibits open 8 AM–2 PM; Forums and activities 9:30 AM–1:30 PM; Prize drawings 2 PM. Programs available Fri. at 7 AM in the Hara Arena lobby and in the tent in front of the East Hall entrance. Flea Market spaces are sold in advance only; a maximum of 3 spaces per person (non-transferable). Limited to amateur radio, electronic, and related items only. Electricity available in a portion of the last Flea Market row for $60 a space extra. Tables and chairs not available. Contact the *Flea Market Chairman by FAX at (937) 253-1289, by E-mail at [fleamkt @hamvention.org]*, or by *voice mail at (937) 276-6932;* allow 30 seconds for the phone routing system to transfer the call. Registration tickets in advance $13, at the door $15. Banquet tickets in advance, $25; after May 17th, if available, $30. Flea Market spaces $50/1 space, $110/2 adjacent, $220/3 adjacent; elec. $60 extra each space. Covered tent w/elec. $325 ea.

MAY 17

COLORADO SPRINGS, CO Pikes Peak Radio Amateur Assn. will host a hamfest at Doherty H.S., 4515 Barnes Rd. Adm. $4; 1st table $12, each additional table $10. AC limited to outside wall tables, bring extension cord. Free parking. Setup May 16th, 6 PM–9 PM; vendors 6 AM on the 17th. Talk-in on 146.97/100 Hz, and 146.52 simplex. Contact *Dennis Major KBØSXC at (719) 535-1160;* or *E-mail [DENNIS.MAJOR@MCI.COM].*

MAY 23 & 24

PASCAGOULA, MS The Jackson County ARC will hold its 3rd Annual Hamfest in the Pascagoula MS Civic Center, Jackson County Fairgrounds. Hours are 1700Z–2100Z May 23rd, and 0800Z–1500Z May 24th. Adm. $2.50 for 12 yrs and older, under 12 free. Tables $8 per 8'. Free parking. RV parking in designated areas only, electric only, no dumping station. Nearby hotels and motels at reasonable rates. VE exams available at 0900Z Sat., May 24th. Prearranged meeting rooms for any amateur organizations. Talk-in on 145.110(-). Contact *Charles F. Kimmerly (Kim) N5XGI, 19000 Busby Rd., Vancleave MS 39565. Tel. (601) 826-5811.*

MAY 25

HILLIARD, OH Flyers, sailors, and amateur radio operators are invited to come and search for that perfect bargain at the Franklin County Hamfest. The event begins at 8 AM at Franklin County Fairgrounds. Adm. $5 per person. Inside tables $5 ea. Outdoor space $5 per 4 wheel vehicle. Setup at 6 AM. Call for advance tickets. Overnight camping with electric hookup is available on the grounds. Contact *Chris Lind, P.O. Box 14281, Columbus OH. Tel. (614) 267-7779; FAX (614) 263-7934.*

JUN 1

MANASSAS, VA The Ole Virginia Hams ARC will sponsor the Manassas Hamfest and Computer Show at the Prince William County Fairgrounds, on Rte 234. Gales open to public 8 AM, tailgaters 7 AM. General admission $5, tailgating $5 additional per space. All activities are wheelchair accessible. Talk-in on rptr. 146.37/146.97 and 223.06/224.66. Unlimited tailgating space. For more information: Commercial vendors contact *Jack N4YIC at (703) 335-9139;* General information contact *Mary Lu KB4EFP. at (703) 369-2877.*

PRINCETON, IL The Starved Rock Radio Club Hamfest will be held at the Bureau County Fairgrounds, starting at 6 AM. Advance tickets are $5 with 4 stubs before May 20th, and $6 with a single stub at the gate. Camping and outdoor flea market area is free. 8' tables indoors are $10 ea. Talk-in on 146.355/.955 PL 103.5. Contact *Bruce Burton KU9A*, or *Debbie Burton N9DRU, 1153 Union St., Marseilles IL 61341-1710. Tel. (815) 795-2201; E-mail [brburton@mtco.com].*

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park., 47-01 111th St. Vendor setup at 7:30 AM; buyers admitted at 9 AM. Free parking. Adm., buyers $5, sellers $10 per space. Talk-in on 444.200 WB2ZZO rptr, and 146.52 simplex. For more info, call, eves. only, *Arnie Schiffman WB2YXB, (718) 343-0172.*

JUN 7

TEANECK, NJ The Bergen ARA will hold its annual Spring Hamfest at Fairleigh Dickinson Univ. Buyer adm. $3, with XYLs and harmonics free. Seller adm. $10. VE exams. Talk-in on 146.790/.600. Contact *Jim Joyce K2ZO at (201) 664-6725 before 10 PM.*

GRAND RAPIDS, MI The annually sponsored IRA Hamfestival will be held at Hudsonville Fairgrounds near Grand Rapids. Doors open at 8 AM for general adm. Dealers can set up on the 6th after 7 PM, or after 6:30 AM on the 7th. Overnight camping. Bring your equip., etc., to sell and trade. VE exams at 8:30 AM. Talk-in on 147.16 link rptr. system. Reserve early for the best spots. Indoor table space and trunk sales spaces available. Contact the IRA voice mail/info line at *(616) 534-6803;* or *Tom KA8YSM* or *Kathy KB8KZH* at *(616) 698-6627.*

SPECIAL EVENT STATIONS

MAY 2, 3 & 4

FALL RIVER, MA W1ACT, the Fall River ARC's annual DXpedition to Martha's Vineyard (IOTA-NAØ46), and Massachusetts QSO Party, will operate on the following freq.: CW—1810, 3550, 7050, 14050, 21050, and 28050; SSB—1850, 3890, 7290, 14260, 21390, 28390, 146.550, 446.000 (FM), 434.0, and 439.25 MHz (ATV). Send an SASE for QSL via *N1JOY, 19 Davis Rd., Westport MA 02790. E-mail [roland-d@ici.net].*

MAY 3

NOVI, MI The 1st Annual Novi Special Race Car (Indy 500) Celebration will be sponsored by the Novi ARC, 1400Z–2100Z. The club will use the callsign KC8FSW. Freq.: CW—7.030, 7.125, 21.050, 21.150; PHONE—14.225, 14.250, 14.300, 21.325. Please request "Car Photo QSL." QSL to *N.A.R.C., P.O. Box 268, Novi MI 48376-0268.* For more info, call *Greg Tullar KB8UBL at (810) 474-3633.*

MAY 3–4

DANBURY, CT The fabulous 1997 Connecticut QSO Party will be sponsored by the Candlewood ARA, 2000Z May 3rd–2000Z May 4th, with a rest period 0400Z–1200Z. Phone, RTTY and CW. For operating rules, contact *CARA, P.O. Box 3441, Danbury CT 06813-3441 USA.* Please remember to send an SASE.

PHILADELPHIA, PA The Olympia ARC will operate WA3BAT from 1300Z May 3rd–2000Z May 4th, to commemorate the 99th anniversary of Admiral Dewey's triumph over the Spanish fleet at the Battle of Manila Bay. SSB/Phone: 3.898.5, 7.248.5, 14.248.5, 21.368.5, 28.368.5, 145.270 FM. CW: 3.710, 7.030/.110, 14.030, 21.040/.110, 28.025. For a certificate, send QSL and a 9" x 12" SASE to *Olympia ARC, Independence Seaport of Philadelphia, 211 South Columbus Blvd., Philadelphia PA 19106 USA.*

MAY 10 & 11

FLOYD, VA The Foundation for Amateur International Radio Service (FAIRS) will operate FAIRS Club stations N4USA, US5WE, BY1QH, 8R1WD AND S21AM, to celebrate the 6th anniversary of FAIRS. Freq.: General portion of 40, 20, and 15 meters. For a certificate, send QSL and a 9" x 12" SASE to *FAIRS, P.O. Box 341, Floyd VA 24091 USA.*

MAY 17

TAMA, IA The South Tama ARS will operate WDØGAT 1500Z–2300Z to celebrate the annual Lincoln Highway Bridge Festival. Operation will be in the General 40–15 meter phone, Novice 10 meter phone, and 2 meters. For a certificate, send your QSL and a 9" x 12" SASE to STARS/WDØGAT, P.O. Box 94, Montour IA 50173.

MAY 31

NEW PORT RICHEY, FL Pasco County RACES "Disaster Fair," will be held 1300Z–1700Z on 14.225/.275 and 28.400(±) QRM. For a certificate, contact *Michelle Baker, EOC, 8744 Government Dr., New Port Richey FL 34654 USA.*

Number 80 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O .Box 2508
Fullerton CA 92633

Many hams can't imagine turning a VHF beam or quad in a moving car, but it's a common sight here in southern California and lots of other places. When signals are weak, nothing else pulls them in and gives sharp directional bearings. What's more, nothing works better when the signal you're hunting is horizontally polarized.

As you remember from studying for your Element 2A test, the orientation of an antenna's radiating elements determines the polarization of the electrical component of the transmitted or received RF wave. Let's say that the path between a transmitter and receiver is line-of-sight. Transmit and receive antennas are polarized at right angles, one horizontal and one vertical. This cross-polarized condition results in the signal at the receiver input being weaker by as much as 20 dB, which is the difference between full scale and zero on most VHF-FM S-meters.

Now imagine what happens when that perpendicularly polarized signal strikes a building, mountain, or other non-absorbing object larger than a few wavelengths. The signal will be reflected or scattered. The scattered signal will have polarization components that are horizontal, vertical, and all values in between. As a result, scattered signals will be stronger at your receiver input than a direct cross-polarized signal.

On a T-hunt, if the polarization of your RDF antenna is not the same as that of the transmit antenna, reflected signals will be enhanced relative to the direct signal. If the hidden T is in an area of high signal reflections and if the polarization you choose is perpendicular to it, you may chase signal reflections from start to finish. Unless the T-hunt rules in your area prohibit non-vertical polarizations, make sure your quad or yagi has provisions to adjust polarization to match the target signal.

The *T-Hunt Book* shows an easy way to put a slipjoint on your quad's boom/mast junction so you can turn the boom to vary polarization. The book also has lots of ideas for easy ways to mount the rotating mast of your beam or quad on your vehicle for safety and ease of use. For an all-electronic method of polarization selection, see "Homing In" for February 1997.

Getting RDF bearings with a yagi or quad is simply a matter of turning your beam for maximum signal and driving in that direction as roads allow. Your receiver's S-meter is usually better than your ears for detecting the signal peaks, so be sure to locate it such that it is easily viewed by the driver and any RDF helpers. When the signal is too weak to deflect the meter, turn for the clearest audio with best "quieting" of noise.

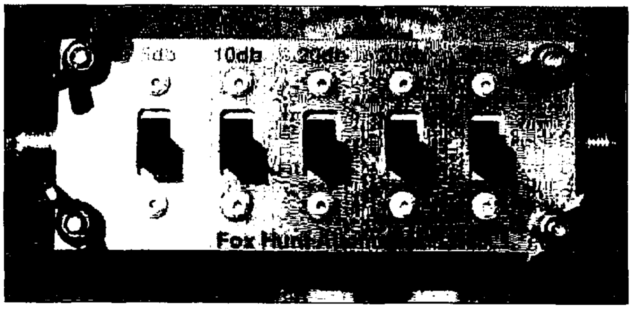


***Photo A.** You will need an RF attenuator for closing in on the transmitter with your beam or quad. This resistive unit was made by Arrow Antenna.*

As you get closer to the signal you're seeking, your S-meter will go to full-scale no matter where the beam is pointed. RF attenuation in the coax line from antenna to receiver will knock the signal down to within the meter's dynamic range. Resistive attenuators like the one in **Photo A** are easy to build at home from plans in the *T-Hunt Book* and the *ARRL Handbook*. FAR Circuits sells a solder-up RF-tight enclosure for your home-brew attenuator to save you a session at the shear. Wired/tested attenuators are available from Arrow Antenna.

Instant bearings from Dopplers

Yagis and quads are simple, inexpensive, and effective for two-meter mobile RDF, but they require the operator to turn carefully and interpret the S-meter readings. If the target signal is varying in power or pulsing on and off, it may be impossible to get an accurate bearing with a bouncing S-meter. On the other hand, Doppler sets do not use signal strength as a bearing criterion.

Dopplers have no moving parts—just an array of vertical whips (usually four) atop the vehicle. The display is a circular ring of light-emitting diodes (usually 16). Dopplers work in conjunction with your existing VHF-FM mobile transceiver, handie-talkie, or scanner, attaching to the antenna and external speaker/earphone connectors.

Switching diodes connect each whip to your receiver, one at a time in sequence. The receiver operates as if it were connected to a single antenna rotating around an invisible vertical axis in the center of the array. This pseudo-rotation causes FM modulation to appear, superimposed on the received FM signal as a tone at the rotation frequency. The phase of this demodulated tone, relative to the antenna switching sequence, determines the direction of the incoming signal.

From an ease-of-use standpoint, a Doppler is nearly ideal. One LED at a time comes on to indicate direction of the signal relative to the front of the vehicle. The top LED in the ring represents signal dead ahead. Dopplers take bearings several hundred times per second, so they can capture a signal of very short duration and hold the bearing to it when the signal goes off.

***Photo B.** Bandmaster quads for two meters are available with two, four or six elements. Note the SO-239 coax connector at the lower corner of the driven element.*

Many hams have successfully built their own Dopplers. The most popular such project for home construction is the Roanoke Doppler, which you can duplicate for less than $150. Complete plans for the display unit and a two-meter four-element antenna are in the *T-Hunt Book*. I recently designed an improved antenna system that is more sensitive, covers a wider frequency range and can be built either as a one-piece assembly or with four ordinary magnetic mount whips. See "Homing In" for April and June 1995 or the "Homing In" Web site for details of this antenna.

By building your own Doppler set, you will save money and learn about Doppler technology. For hams who aren't ready for that or who want more "bells and whistles," two commercial Doppler manufacturers have affordable products for the ham market. The 4000 and 5000 series models from Doppler Systems Incorporated feature a patented method of "soft-switching" the four whips to reduce cross-modulation effects. Prices start at $620 for an LED display unit plus four magnetic-mount whips. Higher-priced models add voice readout, digital bearing output and other advanced features.

NEVER SAY DIE

Continued from page 77

I was "downsized" when the TV station I was working for (KBTV in Dallas) shifted from live programming to all film, eliminating the need for a director for their live shows.

Okay, what's the first letter on the eye chart? That big one up on top? It's an E and for me it stands for entrepreneurialism. That's the subdivision of capitalism that works the best. And it's the key to your freedom from being hired or fired, from commuting, from being downsized, or replaced by a someone in Pakistan who's better educated than you and will work for 10% of what you've been pulling down.

If you're totally wasting an hour or two a day commuting to work, what do I have to do, come and shake you personally to get your attention? How can I get you to wake up and take charge of your life?

And the same thing goes for your health. You've heard the old saw about you being what you eat? Well, you know it's true, but as long as your body is able to survive the crap you've been eating, drinking and breathing, you make do with arthritis, an occasional heart attack, cancer, and other results of your gross neglect.

As far as your health goes, no, I'm not going to tell you what to do. But I am going to aim you at some books which I've found reliable which will let you educate yourself.

Those years you wasted in our public school system did *not* educate you. Wait'll you read some of the books on my list about that scam. It may almost make you mad.

Book list? It's a 28-page list of almost one hundred books I say you are crazy if you don't read. No, I don't sell the books—that would be a conflict of interest. The list includes a brief explanation of why each book will be valuable to you and how you'll benefit from reading it. I've reviewed many of the books in my editorials, but you've forgotten about 'em already. The list is a measly $5 from Radio Bookshop.

Just the books on health that I review can change your life, adding at least an extra 20-30 years of robust health to it.

continued on page 84

The DFjr from Agrelo Engineering is a new entry into the Doppler market featuring digital processing of bearing data. At $350, it includes the LED display and a set of four magnetic-mount whips on an aluminum crossbar frame.

Once the incoming signal is above the level necessary for a Doppler to acquire bearings, direction indications are independent of the signal strength. So how do you know for sure when you are close to the hidden T? When searching with a Doppler on my mobile transceiver, I remove the antenna from my handie-talkie, turn it on and place it on the dashboard. As the signal breaks squelch on the handie-talkie and becomes full-quieting, I am able to gauge my progress as I close in.

A Doppler is rapid-responding, convenient, and easy to mount on any vehicle, but it is not always the best tool for the job. In areas of high signal reflections, Doppler displays may dance wildly, making it difficult to discern a bearing trend. Because they do not use gain antennas, Dopplers are less sensitive than beams. Dopplers are seldom usable at the starting point of southern California's long-distance weak-signal hunts.

Sensitivity and accuracy of the Doppler method is degraded when the target signal is horizontally polarized. In that case, signal reflections are enhanced relative to the direct signal, making tracking much more difficult in urban or mountainous terrain.

The Doppler technique requires a receiver with FM detection, no matter what modulation is on the target signal. Doppler sets will not track non-carrier modes such as single sideband and pulsed noise. Bearings taken while the vehicle is in motion are usually more reliable than when stopped.

End of the road—time to sniff

Sometimes you can't drive all the way to the signal source. The spurious signal you're tracking may be inside a building. Which floor? What room? A hidden T may be in a field or a park, away from vehicle access. RDF on foot when you have driven as close as you can is usually called "sniffing."

International-style radio-orienteering contests are all sniffing, no vehicles at all. If you are tracking the beacon at the end of a high-altitude balloon flight, you may need to look miles away from the nearest road. Your mobile-mounted beam or Doppler isn't suited for these tasks.

A crude way to get bearings in the field is to use body shielding maneuvers with your handie-talkie. Directional antennas are far more effective, however. Usually you have plenty of signal when sniffing, so a small handheld beam of two or three elements is fine. The N6WZI yagi described in "Homing In" for May 1996 is a great do-it-yourself sniffing project. If you don't want to home-brew, consider the three-element yagi from Arrow Antenna or the two-element quad from AAE Bandmaster.

An ordinary resistive attenuator won't stop your hand-held receiver or scanner from being swamped by signals leaking through its case as you approach a hidden transmitter. To get bearings under these circumstances, consider an offset attenuator. The oscillator and mixer stages in this device shift the T's frequency by about a megahertz and control amplitude of the shifted signal. Just retune your receiver to the offset frequency and continue to take bearings. You can purchase an offset attenuator from Antennas West; plans for a home-brew version are in recent editions of the *ARRL Handbook*.

Another way to continue when the two-meter signal is too strong is to track its third harmonic with a dual-band handheld. Normally, harmonics are 40 to 60 dB weaker than the fundamental, so a beam for 440 MHz will get bearings on it to within a few feet. The Bandmaster Q-440-6 quad and the Arrow 440-5 yagi are small enough to tote along when you sniff. The Arrow 146/440-8 has separate elements and feedpoints for both two meters and 70 cm on the same boom.

I am nearly out of space for this month's column, but I'm not out of suggestions for VHF RDF equipment. Come back next time to learn about "buzz boxes" and field-strength meters. You will also find out what TDOA stands for.

My "Homing In" site on the World Wide Web [http://members.aol.com/homingin/] has a wealth of information to help you and your club get started in the fun of hidden transmitter hunting. You will find hot links to sites of many RDF equipment suppliers mentioned in this article. There are several detailed technical articles, including modifications and improvements to popular RDF products. One page lists sources of components and assemblies for home construction of RDF gear, including four makers of circuit boards and kits for the Roanoke Doppler project.

Want to find out about T-hunting in your neighborhood? Check the links page for Web sites and E-mail addresses of RDFers in over 40 urban and rural areas of North America. All of them are eager to hear from "Homing In" readers who might join in their hunt activities. There are even RDF-related links to 15 other countries around the world, most of them in English.

Even if you don't have Web access, I can put you in touch with RDF enthusiasts near you. Send inquiries via E-mail to [Homingin @aol.com] or via postal mail to the address at the beginning of the column. If your club has T-hunts and isn't listed at my site, be sure to let me know about that, too.

RDF Antenna and Equipment Manufacturers

AAE Bandmaster Enterprises
3164 Cahaba Heights Road
Birmingham AL 35243
(205) 970-0622

Agrelo Engineering
P.O. Box 231
Pattersonville NY 12137
(518) 864-7551

Antennas West
Box 50062
Provo UT 84605
(801) 373-8425

Arrow Antenna
1803 S. Greeley Highway #B
Cheyenne WY 82007
(307) 638-2369

Cubex Quad Antennas
2761 Saturn St. Unit E
Brea CA 92821
(714) 577-9009

Doppler Systems, Inc.
P.O. Box 2780
Carefree AZ 85377
(602) 488-9755

FAR Circuits
18N640 Field Court
Dundee IL 60118
(847) 836-9148

Swiech Communication Systems
12218 Greentree Road
Poway CA 92064
(619) 748-0708

Photo C. *The L-Per dual-antenna and receiver set by L-Tronics is designed for on-foot tracking of aircraft emergency beacons as well as hidden ham transmitters. Cathy Livoni KD6CYG is using this one at the Fullerton Airport.*

NEW PRODUCTS

You Need This Book!

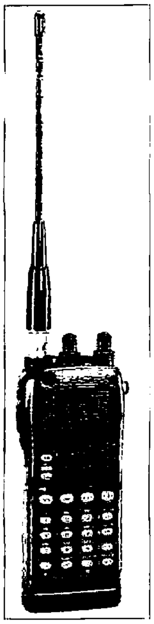
Ferromagnetic-Core Design and Application Handbook is new from MFJ Publishing. Written by the legendary designer Doug DeMaw W1FB, it's a quick, handy reference guide or good study manual for amateur operators, and it's only $19.95. It's also the only book that emphasizes the practical aspect of magnetic core materials from low frequencies through UHF.

DeMaw gives you an in-depth understanding of theory and many practical circuit examples using toroids, rods and pot cores of ferrite and powdered iron. You also get lessons about proper core selection versus operating frequency, circuit Q, power handling capability, and physical mass. Equations are used only when needed to illustrate a concept or design example—tedious mathematics have been omitted to make the *Handbook* easier to understand.

Order toll-free by calling (800) 647-1800; for more information or your nearest dealer, contact MFJ Enterprises, Inc., 300 Industrial Park Road, Mississippi State MS 39762. Telephone (601) 323-5869; FAX (601) 323-6551; or check out the Web site [http://mfjenterprises.com].

Happy 40th!

The Cubex Antenna Company proudly announces its new line of 40-meter antennas—the "Mantis." The Cubex 40th anniversary antenna, it's available in 2 and 3 elements, and up to 7 bands. Prices range from $1,199.95 for a 2-element 40-meter antenna on a 15 x 3 boom to $2,379.95 for a 7-band antenna featuring 4 elements on 10-12-15-17 and 20 meters and 3 elements on 30 and 40 meters. Contact Cubex for details: 2761 Saturn Street, Unit C., Brea CA 92821. Telephone (714) 577-9009 or FAX (714) 577-9124.



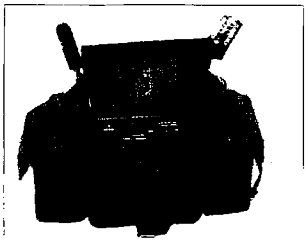
User-Friendly Handhelds

ICOM Inc. brings you the IC-W32A (US version) and the IC-W32E (Europe version) handheld high performance dual-banders to meet the demands of both the novice and the experienced operator: simple operation and advanced features.

The W32 series has separate tuning and volume controls for each band on the top panel, allowing independent adjustment of either band. A new function, the VHF/UHF exchange, allows you to assign VHF/UHF tuning and volume to either knob—set your preferred band to the knob that gives you easiest access.

Independent main and subbands let you receive both VHF and UHF simultaneously, or use the V/V or U/U functions for receiving two frequencies on the same band. There are 200 memory channels; assign a name of up to eight characters from the keypad, and, through the use of an optional cloning cable, transfer stored information from one IC-W32A/E to another. There's a ton more stuff you'll want to find out about, so contact your ICOM dealer or ICOM America, Inc., 2380-116th Avenue N.E., Bellevue WA 98004; phone (206) 454-8155.

More Power

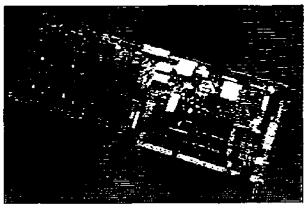


The new Powerport 149 from Cutting Edge Enterprises may be just what you've been looking for, if you need to run/charge radios, soldering irons, test equipment, emergency lights, laptop computers, video cameras, handheld GPS receivers, FAX machines, electric hand tools—pretty much anything that requires power.

The Powerport 149 weighs nine pounds, measures 4" x 4.5" x 6", and provides 140 watts of 115V AC (surges to 200W), and up to 20 amps of 12-volt DC power. It will keep a portable fluorescent light going for more than 24 hours, or a hand-held radio running for 80 hours. Can you think of an emergency situation that *couldn't* use one of these babies?

Powerport can be charged in your vehicle through the cigarette lighter without the engine running, or it can be left plugged into a wall outlet without fear of overcharging. Flexible solar panels are an option, as is the padded carrying case, with detachable accessory pouches.

For further information contact Roger Hall at Cutting Edge Enterprises, 1803 Mission St., Suite 546, Santa Cruz CA 95060; phone (800) 206-0115.



ST-108 Spread Spectrum Matched Filter Demod

SIGTEK, Inc., announces the release of the ST-108 Spread Spectrum Matched Filter Demodulator for cellular CDMA, satellite, and point-to-point microwave applications. The board supports direct sequence chip rates up to 30 MHz and data rates in excess of 2 Mbits/sec. The PC/AT compatible ST-108 is available with either a 70- or 140-MHz IF. Programmable digital filters shape and filter the input signal for optimum performance. A programmable 1024 digital matched filter provides instant signal acquisition. An optional daughter board adds powerful concatenated Convolutional/Reed Solomon Forward Error Correction.

The ST-108 is controlled through a sophisticated Windows 95™ interface that allows rapid setup of all key parameters such as input filtering, chip rate, spreading code, and data format. A DLL is also available for standalone applications. For more details, contact SIGTEK, Inc., at 9841 Broken Land Parkway, Suite 206, Columbia MD 21046. Phone (410) 290-3918 or FAX (410) 290-8146.

Manufacturers: your product releases could be here. Contact Priscilla Gauvin at: 73 Magazine 70 Rt. 202N Peterborough NH 03458.

NEVER SAY DIE
Continued from page 81

There's an awful lot of baloney out there in the alternative health field, so you need someone to sort things out for you.

Now, getting back to the big E. If you've forgotten the things I've written about that down through the years, you'll do well to invest $5 in my *Making Money, A Beginner's Guide*. Every now and then I get a phone call or letter from a graduate of Green's School of Entrepreneurialism thanking me for changing their lives. I want to get you to consider the freedom I offer and go for it so I'll get that letter from you in a couple of years.

The strength of our country lies in small businesses, not in giant industries. As far as I know, every big business is crooked and aiming to get bigger and bigger. When they get really big they become international and their interests aren't the same as ours. But with their money they have the power to pretty much control our country via hordes of lobbyists in Washington and every state capital.

So stop wasting your life working for someone else and start thinking about having your own business.

Darn, they're making soap boxes out of cardboard these days and they keep breaking.

Cancer!

A hundred years ago cancer was almost unknown. Today it will affect the lives of at least 50% of you. It's more like 100%, if you count your family. So what's gone wrong to bring on this epidemic, and how come the medical industry has been almost powerless to do anything about it?

As you read the books I've recommended on health you'll find that our medical industry is centered on treating symptoms, not getting at causes so that illness can be prevented. So what's causing this cancer plague? And what can *you* do to avoid being another victim? The major problem seems to be a weakening of our immune systems, caused by an increase in our poisoning ourselves. Poisoning? You bet! We're doing a real job on ourselves with stuff like aspartame (a.k.a. Nutrasweet™—the blue stuff), fluorides in our drinking water, chlorine ditto, dioxin ditto, dental amalgam (mercury poisoning), air pollution (how well are you filtering the air in your home and office?), keeping needed UVs out of our eyeballs, eating crap like sugar and white flour products, burgers and fries, meat laced with growth hormones, fruits and vegetables grown in almost totally mineral-depleted land. We're giving our bodies a fraction of the water it needs to flush out toxins. And have you read the list of chemicals they're putting into our foods to keep it from spoiling on grocery shelves? Do you really think that stuff won't collect and screw up your body? And I'm not even going to bother mentioning the effects of alcohol, cigarettes, and caffeine. Ooops, I almost forgot root canals and EMFs.

Over a million years or so our bodies developed to work best on the nutrients then available. Now we've changed all that and we wonder why we're doddering into nursing homes in our 60s instead of raising hell?

So we poison our bodies into sickness and then we go to the doctor and get an expensive medication. Another poison. The $1.5 trillion medical industry is controlled almost totally by a few major pharmaceutical companies. Their worst nightmare is an inexpensive cure for an expensive illness. And remember, nobody in the industry makes any money until you get sick. That's when you'll spend whatever they demand to get well. And this is happily supported by the insurance industry (you've seen their huge modern buildings, right?), which also has a large negative interest in your being healthy. When you get sick they pay, and that's known as cash flow. Then they charge higher premiums. They get their cut, so the more they have to pay out, the more profit they make.

Start reading the books on health on my list. The Comby book on a raw food diet. The Batmanghelidj book on water. The Wallach book on playing doctor. The Coca book on allergies. The Lane book on shark cartilage, which looks like one of the best answers to the cancer problem, once you've poisoned your body to that extent. Cayenne to avoid heart attacks.

The Bioelectrifier looks like it can help rebuild immune systems, and colloidal silver holds some great promises. I'll try to keep you up to speed in these fields as I learn more.

But if you keep putting sand and sugar in your gas tank, your engine isn't going to last long and you'll be doddering with your walker to hamfests. Or zipping around in one of those handicapped mobiles. So go ahead, hoist a few more beers and buy another carton of cigarettes.

I eat mostly vegetables and fruit these days. I'd eat more meat if I knew where to buy meat safe enough to eat raw. I love raw meat and raw fish. Sashimi. In Tokyo I was treated to a chicken dinner that started out with chicken sashimi and it was delicious. But the chicken we get from the supermarket is so laced with salmonella and other microbes that it's as dangerous as eating blowfish. Hey, I've got to find out more, but I'll bet a good dousing in silver colloids might make fish and meat safe to eat raw. Do you know anything about that? It seems reasonable, but I'm not yet ready to bet my life on it.

Yes, I've eaten blowfish. And survived. I recently saw the episode of "The Simpsons" again where Homer ate some and was told he was going to die in 24 hours.

Speaking (well, writing) of medical alternatives, if you think I'm alone in putting down the medical industry, do some alternative cruising of the Internet. Check out the Royal Rife Web page and see what that bunch has to say about the medics and their support by the feds, which is an incestuous relationship.

One of the books on my list is about Dr. Naessens, who, like Rife, but more recently, invented a super-powerful microscope. And he, like Rife, was thus able to see an even more basic form of life than the cell, one which seems almost indestructible. He called it a somatid. And he, like Rife, was persecuted by the medical establishment, complete with swat teams raiding his laboratory and destroying his notes and equipment. Well, he, like Rife, did a terrible thing: he found an inexpensive cure for cancer and used it to cure a bunch of people.

Screw the Generals

No, good heavens, not General Class operators—I'm referring to such generals as General Motors, General Foods, General Mills, General Instrument, and General Dynamics—the gigabuck conglomerates. Capitalism works first rate when it comes to smaller businesses, but it goes awry when corporations get big enough to dominate an industry.

I keep a copy of Ted Quinn's 1953 book, *Giant Business, Threat To Democracy*, at hand. Ted had been an insider, the vice president of GE, and saw what was going on when corporations get too big. Not only can they squash or limit their competition, they also have lobbyists in Washington to make sure that they have the government behind them in doing it. Larger corporations have lobbyists in every state capital too. I was amazed when I looked over a list of the registered lobbyists in Concord, my state capital.

The real strength of any country lies in the proliferation of small businesses, not in growing giants, which tend to be international entities, with it being irrelevant where the owner is.

For a while our government tended to keep a loose lid on bigness with their anti-monopoly suits, but how long has it been since you've read about one of those? They did break up AT&T and slowed IBM down for a few years, but these days we're seeing the big get bigger by gobbling up the other big guys as well as bundles of smaller businesses.

I don't have any proposed solutions for this weakness in capitalism, I just wanted to make sure that I have company in worrying about it. Since the giants are essentially running the government, we can't really expect much help from that quarter. And, until we're able to improve our school system, we're not going to have many people with the guts to cooperate to do something from the grass roots.

A recent letter from a reader mentioned that a psychology professor opined that our school system destroys initiative in all but about 5% of the people. That helps explain why I'm up here on my soap box waving my arms in dismay to so few people. Everyone else is hypnotized somewhere watching a ball game. Or at a church supper.

Shortchanged

I've been shortchanged. You've been shortchanged. We've been

lied to, hypnotized, and brainwashed by the media, the school system, and the government... with the result that around 99% of us are taking all the crap that's going on and believing that there isn't anything we can do that will make a difference. Imagine what a country this would be if 250 million people decided to make a difference! Heck, if just a few thousand decided that they were going to actually do something about the mess.

We're taught in school that honesty pays. Well, that's hooey! Another con job. Honesty doesn't pay worth beans. I've had bigger screw jobs than anything you can imagine, and not one was done honestly. Hey, I had a $100 million property stolen and there wasn't one damned thing I could do about it.

Every industry that I've gotten into has turned out to be crooked to the core. I've written about the magazine distribution industry and its crime connections. And about the music industry, also with organized crime connections. Not one industry that I've gotten to know about intimately has turned out to be honest.

Our country is run by crooks. I'm exaggerating? Then you haven't done your homework and read the books on my list of *98 Books You're Crazy if You Don't Read*. I'll bet you haven't even read P.J. O'Rourke's *Parliament of Whores*. If the government was honest there wouldn't be thousands of lobbyists being paid billions of dollars every year to bribe government officials.

You? Hypnotized? Brainwashed? Sure, get angry with me for bringing it up. But, just for a minute, remember the denial alcoholics and other drug abusers are into. Remember that when someone is given post-hypnotic suggestions (orders) they will faithfully carry them out, rationalizing their every action.

If you are commuting to work ...if you are worried about being downsized, outsourced, laid off, fired, then you're in need of a deprogramming intervention. If you don't love what you're doing you've been brainwashed into accepting a sort of slavery. Slavery to big government and big business.

Does it bother you that the first five months of the year you are working for the government? Or is it six now? So what are you getting in return for all that time and work? Hmm, let's see. We get roads to drive our cars on. Of course, unless we pay a stiff tax on our car every year, we can't use it. And the gas we use is taxed too. Indeed, that alone is supposed to be paying for the roads. But that's a state matter, not federal. What is the federal government doing for us?

Well, there's the military. Yep, we gotta have one of those. Well, there goes 5% of the federal budget. We get the services of the FAA, which makes flying safer. Okay. And we get the FCC, which regulates the airwaves. There's some good in that too. And there are our national forests and parks.

Well, how about social security? As Steve Forbes has pointed out, if the feds would let us put aside the same money in private accounts we'd get back almost four times as much as we do now. Well, it costs a lot to support millions of government employees and their generous pension funds. Social security is one hellaceous screw job. It's just another tax where they, in essence, take around $4,000 from a senior every month and give him $1,200 back. Here, let's see you live on that, old-timer.

If you weren't totally brainwashed you'd never in this world send your kids to a public school. And you'd be pretty angry over the poisoned garbage being sold by our supermarkets. I'm exaggerating? I wish I were, but then I haven't been able to get you to do your homework and learn what's actually going on. I'm not asking anyone to believe me, but I am asking that you check out the books I've found that make a lot of sense to me and which will give you a new perspective on things.

So you go along doing things you know you shouldn't and not doing things you know you should, and then when you finally break down your body you go to a doctor. Hmm, headaches, eh? Here's some pain killer. Cancer? Lordy, we've got to pour some industrial-strength poisons into your body and kill that damned cancer. If you ever find a doctor who tries to find out why you have the cancer, please let me know. I don't expect any mail to result from that request.

When you get sick it's because you've done it to yourself. The element of chance is what organ or part of your body is going to crap out first. But you go merrily on, knowing or not knowing how you're lousing up your body. Your "education" did not teach you much about body maintenance, and even less about continuing to learn all through life. So you suck in on a life of Cheers bars, bowling, or watching ball games. Or sitcoms. And commuting to work until a computer or a Pakistani replaces you.

Wayne Disappears!

A call from René, who wrote the book *NASA Mooned America*, which he's self published, reminded me that Bill Kaysing, who wrote *We Never Went To The Moon—America's $30 Billion Dollar Swindle*, is suing one of the astronauts who called him "crazy" for libel. The case comes up in October, so Bill and René are busy organizing exhibits which will back up their contention that all the moon landings were faked.

I get kooky books sent to me all the time, so when René sent me a copy of his book I sighed and expected to read the usual polemic. Well, I've written about my conversion. Since then I've helped René sell hundreds of his books and not one person who's read his NASA book has written to say he thinks René has his facts wrong.

Kaysing, who worked for Rocketdyne during the years when they were developing the engines for the Apollo program, knew that the engines powerful enough for the moon shots had all failed and that the engines they ended up using couldn't possibly provide enough power for the trip. Knowing that the moon shots were impossible, Bill started researching the project, looking for other deceptions... and he found plenty.

Kaysing's book makes some of the same points as René's, but he also has a bunch more. Like the pilot of a commercial airliner flying to Tokyo who reported seeing a high-flying plane drop a command module, which then chuted to the ocean below. Or the recording NASA released of Armstrong and Aldrin talking with Mission Control while descending to the moon. The problem here is simple; a rocket engine developing 10,000 pounds of thrust generates about 140 dB of sound, so voices anywhere near it couldn't possibly be heard. And so on, for a long list of contradictions.

Now, will NASA and the CIA, who apparently worked with NASA to put over this charade, let this come to trial or will Kaysing and René both disappear or inexplicably die... as have several other whistle-blowers? Will they be after me too? I've already had one government agent tell me flat out that if I ever wrote about his agency again he guaranteed I would be put in prison and never get out. No, I haven't written about them again.

The government we have today bears little resemblance to that envisioned by our founding fathers. No, it's not as bad as Russia or China, but we sure could use some housecleaning. And the Senate too.

How could NASA and the CIA pull off a $40 billion swindle like that? Well, you saw the *Apollo 13* movie, right? That was a movie. And maybe you saw *Capricorn One*? Well, rent it, then.

When Kennedy said we'd go to the moon and Congress budgeted for it, NASA was faced with a serious problem when they later discovered that they weren't going to be able to do it. Should they give up years of nice-paying jobs or fake it? Not many people had to know the truth, so there was a good chance of maintaining secrecy.

Since I originally wrote about René's book I've heard from several people who were not at all surprised as a result of their own work on NASA and related projects.

Well, I hope they won't feel it necessary to terminate me—I just have so much more to write and do before termination. And I'm anxious to be around to see if the prophecies for world cataclysm in 2000 and 2012 pan out. Golly, I'd sure hate to miss out on a cataclysm.

The Magic Bullet

While we're healthy we don't give much thought to preventing illness. When we get sick we look for a fast remedy—at least something to get rid of those darned symptoms. The body has an excellent repair system built in, but it can be disabled, allowing all sorts of opportunistic invaders to take hold.

The Bioelectrifier looks like a good approach to helping the body get rid of invaders such as microbes, parasites, yeast infections, viruses, fungi, and so on.

Continued on page 88

QRP

Number 86 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
P.O. Box 508
Massillon OH 44648

Last month, I mentioned I would be presenting a different project. However, this is a project you should not necessarily run out and build. It's more of an experimental project, although it does serve a real purpose in life.

The project

As odd as it sounds, the project is a ten-minute ID timer. As I said, nothing special. Oh, no? What makes this timer different is how it works. But first, some background on the ID timer.

Another project—another circuit

I had been working on a different project and needed a way to produce a pulse every ten minutes or so, and at the end of the pulse, the output had to stay on for a second or two as well.

Normally, when someone needs a circuit for a simple timer such as I described above, an LM555 timer is used. However, in this case, I also needed a two-second pulse at the end of the time period. With two separate time periods, that would require two LM555 timers, or one dual timer, the LM566.

This was not acceptable. I needed a very small parts count for the circuit I was developing, and adding one more chip was not an option. In fact, I did not want to add a single chip to the project. I had one section of an op amp left with which to build a long-duration timer and produce a two-second pulse.

I also required the circuit to reset and start timing again once the long-duration time period was up, so what you see in **Fig. 1** is the result of many hours of daydreaming and lots of paper!

How it works

My one section of an LM358 op amp is the heart of the timer. For clarity, I show this one section only. The other section is used by the rest of the circuit and is not required by the ID timer.

Generate the ten minutes

The Vcc in this ID timer is +8 volts. I used a small 78L08 regulator. It's part of the overall circuit and not shown in this schematic. Vcc is applied to R7 and slowly charges C1. Capacitor C1 is a husky 4700 µF electrolytic capacitor. The time it takes to charge is determined by the Vcc and R7. For this reason, we use the eight-volt regulator to ensure a constant timing period.

The positive input of the LM358 monitors the charge on C1. The negative input of the LM358 compares the charge on C1 to the reference generated by R16 and R17. In effect, they divide the Vcc by half. Again, another reason for the regulated Vcc required for the ID timer.

With the values shown for R7, it takes about 9 minutes for the charge on C1 to match the reference on pin two of the op amp. The R/C time constant makes up the long-term time period of the timer.

When the comparator switches states—it is normally off or low—several things happen.

First, the long-duration timer must be reset. This is accomplished by turning on Q2 via R18.

Now we must also generate the two-second pulse at the same time. To accomplish this feat, I added some rather heavy hysteresis to the op amp. This hysteresis loop consists of R10, D4 and R8. When the op amp switches, this hysteresis loop will offset the voltage of the R7/C1 sample, effectively holding the output of the op amp on slightly longer. However this is still not enough to produce the two-second pulse.

I had to add R9 to slowly discharge C1. The trick was to find a value of R9 to produce the required two seconds while discharging C1 down enough to generate another ten minutes' worth of charging. If you increase the value of R9, you get a longer pulse at the end, but you shorten up the time it takes to recharge C1. Make R9 smaller, and you get a shorter pulse and longer recharge time on C1. With the values I have shown in the schematic, you'll get a two-second pulse about every 9.3 minutes.

You can also change C1. Adding more capacitance will of course make the timer run longer. A smaller value for C1 will reduce the timing cycle. If you don't have one large cap, feel free to use several in parallel.

The output from the op amp can be used to drive an LED or tone generator. I use a solid-state sounder I picked up from a hamfest. Its low current allows it to be driven directly from the LM358's output. If you require higher output switching, you can use a transistor switch as shown in the schematic. Basically, it's just a cheap NPN transistor that's turned on by the output of the LM358. If you decide to use a relay as the high current switch, be sure to add a small diode across the coil's terminal to prevent the EMP pulse from zapping the switching transistor.

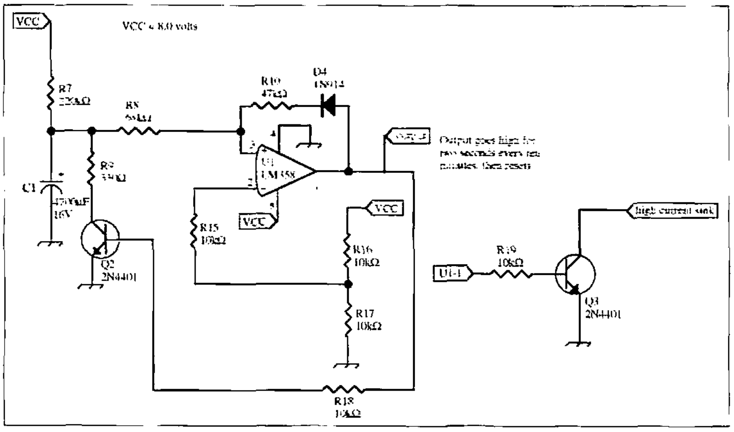


Fig. 1. The low-tech 10-minute timer, shown with the high-current driver option.

Building the IDer

I have no PC board for this project. I figured it would take about as much time to lay out a PC board as to use point-to-point construction. Perfboard would be the first choice for me. I used a prototype solderless setup to test the circuit. If you don't have one of these, I suggest you invest in one.

Keep the Vcc steady; aside from that, you can use +12, +8, or +5 volts for the Vcc. If you change the Vcc from the +8 volts I used, you may have to fudge either or both R7 and R9. There is no need to change out R16 or R17. They will divide the Vcc in half regardless of the Vcc used.

You can save some money by getting C1 with a 16 VDC rating. The Digi-Key price for the cap is about $4 each. I've seen caps that will work from Hosfelt for a quarter a pop!

The entire idea of the ID timer is to use a leftover op amp in one of your projects. You may have one section left over from an audio filter in a direct conversion rig. Here is your chance to wire up an ID timer without adding an extra chip.

Playtime

For goodness' sake, please play with this circuit. It's meant to be changed. Use the basic circuit to start with and change values as you go. If you have a leftover op amp in one of your rigs, go ahead and build in an ID timer!

QRP kits from Ten-Tec

Here's some info on the newest QRP kits from Ten-Tec: The new rigs are designed for 80, 40, 30 and 20 meters. Easy to build and simple to operate, each unit covers a 50-kHz segment selected at time of construction. Kit includes all required components and professional enclosure painted and fully silk-screened. Receiver performance is superlative and QSK is just what you expect from the hams at Ten-Tec. I'll have a complete review of this new QRP transceiver from Ten-Tec. Look for it soon. Next month, I'll have some ideas for running our low power rigs on batteries in the field, and other interesting stuff.

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

May is expected to be a rather bland month for DX propagation because of the approaching summer solstice, although there may be some days of high sporadic E propagation. Look for prime conditions (G) between 1-4, 9-17, and the 31st. Look for only fair (F) conditions 6-7, 19-21, 25, and 29th. The remainder will be trending. I don't foresee any major ionospheric or magnetic field upsets or any major geophysical problems this month. At the time of preparing this forecast (February), the solar flux remains at a disappointing low value of between 70 and 75, with no apparent upswing yet in sight. Sunspot numbers continue low, and the sun is very quiet. Considering this prolonged minimum, I suspect cycle 23 will be off to a slow start and a low peak of 150-200 flux units sometime around the year 2003. Most observers consider an average solar cycle to be around 11.2 years, but there seems to be mounting evidence that the *true* cycle is closer to 23 years on average—with two peaks and three minima—similar to a sine wave, if you want to visualize it. I fervently hope this rather gloomy forecast is wrong, but we'll have to wait and see, won't we?

MAY 1997

SUN	MON	TUE	WED	THU	FRI	SAT
				1 G	2 G	3 G
4 G	5 G-F	6 F	7 F	8 F-G	9 G	10 G
11 G	12 G	13 G	14 G	15 G	16 G	17 G
18 G-F	19 F	20 F	21 F	22 F-P	23 P	24 P-F
25 F	26 F-P	27 P	28 P-F	29 F	30 F-G	31 G

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

10-12 meters

You may expect occasional short-skip openings from about 500 to 1500 miles. There may be rare openings to greater distances, but not regularly.

15-17 meters

You can expect some reasonable short-skip propagation out to 1500 miles or so, and occasionally greater distances, particularly transequatorial DX skip—with sometimes surprising signal strengths.

20-30 meters

As almost always, 20 meters will be your best DX band for both daytime and evening periods. Twenty will stay open until well after dark, and thirty really begins to shine in the late evening hours. Peak conditions exist shortly after sunrise at your location, and again in the late afternoon. Midday conditions are not likely to be good due to excessive ionization and absorption. Short skip will be excellent out to about 2500 miles on both bands on the best days.

40-80 meters

Forty will be excellent after dark unless the noise levels from thunderstorm activity are excessive. These will be "all-night" bands, with 40 slightly better than 30, except for noise. Daytime short skip will average 1000 miles or more and nighttime short skip will average 1500 miles or more—usually more.

80-160 meters

These two bands are not known for summertime DX, and May is close enough to summer to be a problem because of high noise (QRN) levels. However, on quiet evenings you may find superb DX across the Atlantic on 80 meters for US and European hams. One-sixty is always a summertime problem, but those of you with Beverage antennas for receiving and vertical antennas for transmitting will do better than average.

Gray-line DX

Always be aware that a half hour before and after local sunset often provides some really fine DX along the paths of darkness on all bands. *Use it* to your advantage. W1XU. 73

NEVER SAY DIE

Continued from page 65

But these beasties wouldn't likely have established a beachhead if the immune system was working well, so getting rid of them is only going to be temporary unless you make some changes.

The Bioelectrifier, or Beck Blood Purifier, was originally developed as a way to fight the AIDS scourge. But the alternative health care field is no more honest than our medical-pharmaceutical-insurance-FDA-NIH-etc. monopoly, so who knows what to believe? There are crooks and hucksters at every turn. The medical (etc.) industry has the government behind it because that's where the big money is. The doctors' organizations, nurses, hospitals, drug and insurance companies (etc.) all have well-heeled lobbyists with bribe money to invest in our politicians to make sure their companies prevail.

Now that there's no question but that vitamins help keep us healthy, the doctors via their lobbyists and their kept politicians are pushing the FDA to make sure that doctors get a piece of the vitamin action by making them available by prescription only.

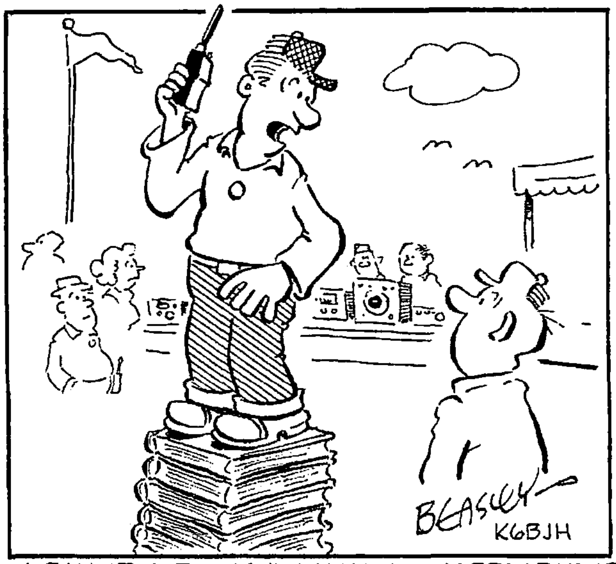
Now, getting back to staying healthy. There are two major factors which combine to make us sick. One is the lousy treatment we give our bodies and the other is stress—the psychological factors. A long time ago I reviewed a book, *Who Gets Sick*, by Dr. Blair Justice. I'll have to add that to my list of books you're crazy if you don't read. Blair makes an airtight case for the triggering effect of psychological problems. Almost 50 years ago, when Hubbard proposed this concept in his book, *Dianetics*, it was ridiculed by the medical establishment. Germs make people sick, not bad thoughts. Doctors have gradually come to accept the idea, but (as I've mentioned a few dozen times) none of them that I've ever heard of is doing one darned thing about it. They're busy treating symptoms with chemicals and knives, and to hell with the actual causes of the illnesses.

You gotta have both germs and bad thoughts. And a weak immune system.

So, sure, the Bioelectrifier may be able to work some temporary miracles, but in the long term you'd better start cleaning up your act, with both good nutrients and good thoughts.

A reader, whose father managed to blind himself by staring into the sun, was aghast over my mentioning the importance of getting UVs into your eyeballs. Hey, I keep asking you to get my review of the books you really need to read, and one of them, by Dr. William Douglass, explains in detail about UV-ing your eyes and the sicknesses that ensue when you don't. Which most of us don't. We keep windows in our homes and cars between the sun and our eyes. And then, when we go out, we wear sunglasses. I haven't worn sunglasses since reading the book. Read the book! And no, I'm not recommending anyone stare directly into the sun. But you can cast your eyes into the sky near the sun so it can get into them without frying them. It only takes a few minutes a day.

Read the books on water, our missing minerals, on a raw food diet, and so on. Either educate yourself and start avoiding things which will make you sick (no matter how good they taste), or suffer the consequences, turning to your doctor to try and effect repairs. Whoo, is *that* an expensive and painful way to go! 73



I FOUND A BOOK ON HOW TO INCREASE YOUR HANDHELD RANGE--- I BOUGHT A DOZEN COPIES, BUT MY RANGE IS ABOUT THE SAME

UPDATES

Number 88 on your Feedback card

Beam-aimer project.

In the February 1997 issue, **Fig. 4** on page 18 and **Fig. 6** on page 20 were wrong. If you are interested in Mr. Garrison's beam-aimer project contact us. We will be happy to supply you with full-size layouts of the copper sides of both boards. Please send a 6" x 9" SASE.

Rusty Auxier KG4AU address correction.

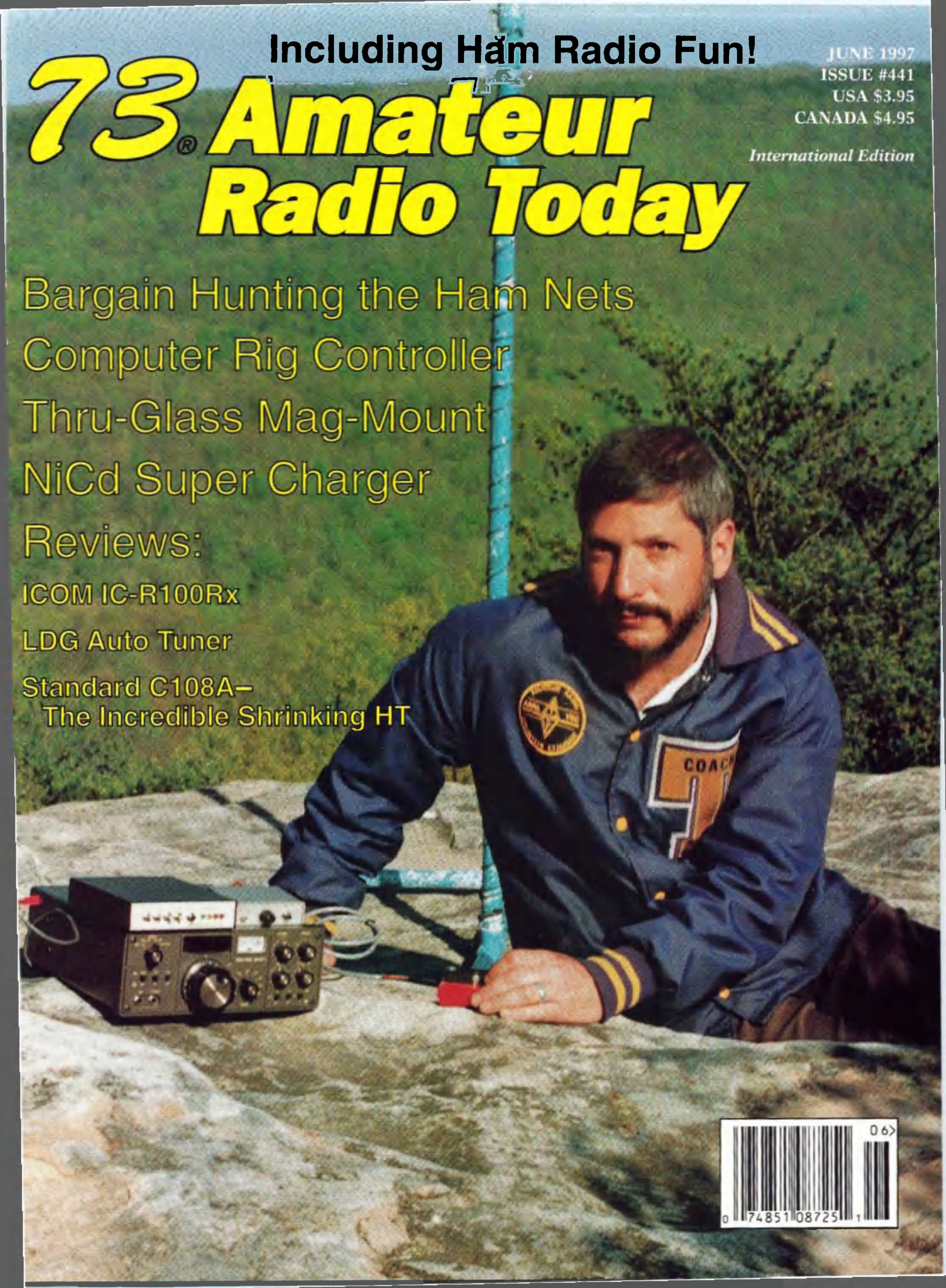
In the February 1997 issue, Rusty Auxier KG4AU, president of the Guantanamo Bay ARC, appeared in our Ham Help section. His E-mail address was incorrect. It SHOULD HAVE BEEN [rustman1@aol.com]. 73

Including Hăm Radio Fun!

73 Amateur Radio Today

JUNE 1997
ISSUE #441
USA $3.95
CANADA $4.95

International Edition



Bargain Hunting the Ham Nets

Computer Rig Controller

Thru-Glass Mag-Mount

NiCd Super Charger

Reviews:

ICOM IC-R100Rx

LDG Auto Tuner

Standard C108A–
The Incredible Shrinking HT

73® Amateur Radio Today

Including Ham Radio Fun!

JUNE 1997
ISSUE #441

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

REVIEWS

HAM RADIO FUN SECTION

On the cover: Conard Murray WS4S captured Jeff Gold AC4HF mountaintopping with his LDG Auto Tuner. Both are from Cookeviile TN. Next month: YOUR cover shot? Submissions gladly welcomed. Why not make a little extra cash?

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The entire contents ©1997 by 73 Magazine. No part of this publication may be reproduced without written permission of the publisher, which is not all that difficult to get. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

Never say die

Wayne Green W2NSD/1

Bio News

Have you built a bioelectrifier (May 1996. May 1997 *73*) so your doctor can check out its potential for eliminating viruses. yeasts. microbes. fungi. and parasites from the blood of his patients yet? I've been getting some enthusiastic letters from readers reporting remarkable results: "More black hairs on my head—teeth and gums improved—improved vision—improved elimination regularity—it seems like every day I discover something that works better, what a miracle!"

Well, you can lead a horse to water. Through my book reviews (etc.) I've pointed out how you can add at least another 20-30 years to your life expectancy. Years of robust health, not doddering around a retirement home, awaiting the inevitable heart attack, cancer or stroke. But getting you to change your lifestyle by taking advantage of this information is totally beyond me.

Yes, you want me to write about amateur radio. And hamming is fun. It's a lot more fun when you are 100% healthy. And it's a lot more fun when you take advantage of the adventure the hobby provides. It may be putting up a 500-foot antenna via a kite or balloon, or lofting a little ATV camera via a balloon. Or maybe a little long weekend trip to St. Pierre (FP8) for a mini-DXpedition. Or getting together with a half dozen other adventurers for a few days on Navassa (KP1), fielding the humongous pileups.

Yes, of course I'm frustrated at your insisting on commuting to work every day instead of having your own business. You obviously haven't read Danko's *The Millionaire Next Door*. Or my book, *Making Money*. A little over 1% of Americans are millionaires, so is it really all that difficult for you to imagine being more successful than 99 of your friends? It doesn't take much more effort, only a redirecting of your life—out of the rut the other 99 are in. And, in the case of healthy living, out of the rut 99.999% of the others are in. You only have to look in the market baskets at the supermarket and then at the pushers to see the correlation between the food they're buying and how healthy they don't look.

In the short run it does seem as though the bioelectrifier can work some miracles. In the long run it's your mouth that will work more health miracles, and your understanding of the secret of making money that will determine whether you have any real freedom or not. I hope you'll opt for change so that in a couple of years you'll be asking me to go along on a DXpedition with you to Minerva Reef or some other weird place. I'll bring a rig and my scuba gear and we'll have a ball! But if you're going to climb that ladder up the cliff at Navassa, you're going to need all the energy you can muster. It's a corker.

Pirating

I was talking with John Ramsey of Ramsey Electronics the other day and I asked him which of his kits was his best seller. He said it was his FM transmitter kit. It seems that my preaching about entrepreneur-ialism hasn't fallen totally on numbed ears and school-system de-motivated psyches. More and more hams are going into business for themselves selling, installing, and servicing low powered FM transmitters. The applications? They're only limited by their imaginations.

Some businesses and hospitals use them for distributing music. Some use them for paging systems. Others set them up with a cassette recorder, CD player and a mixing board as a pirate broadcasting station serving their community. No, the FCC is not delighted about this, but unless there are a bunch of complaints, not much seems to happen. And then, they issue a warning before sending in the swat team to confiscate everything in sight and levy a fine or impose a prison stay.

These low powered rigs don't cause much trouble, though now and then some enterprising pirates can't help setting up an outside antenna and adding a pair of shoes. Yes, Ramsey sells a beaut of a 30-watt amplifier which absolutely, positively should not be used for pirating.

Some hams are getting real estate agents to set up the FM rigs in houses they have for sale, using an endless loop tape telling about the property. Prospects have merely to tune their car stereo to the channel and get the sales story when they visit the properties recommended by the realtor.

Now get those little gray cells out of neutral, where they've been idling for the last few years, and come up with more uses for these li'l dyn-o-mite gadgets.

Golly, what a great pirate station I could run! I've got a killer collection of CDs for music, and an endless bunch of things to talk about. Ask anyone who's heard me at Dayton. What I don't have is the time to do something fun like that. Also, while the FCC may find it merely annoying when they get complaints about a pirate FM station, if the guy running it turns out to be a ham, he'll probably lose his ticket. Sell 'em, install 'em, service 'em, but don't operate 'em if they're going to cover more than is permitted for low powered unlicensed devices.

FCC Swat Teams

One part of the new Communications Act that Congress passed last year was a sleeper called the "Communications Decency Act." This beaut provides criminal sanctions (a.k.a. prison) if a minor is exposed to "indecent" or "patently offensive" material via telecommunications, and that includes amateur radio as well as the Internet—and even Howard Stern. A lot of fuddy-duddy groups are upset over this—like the ACLU.

Of course there's no way to define "patently offensive," so this will be great meat for lawyers. Well, they don't have nearly enough to do, as we can see from the endless law firm ads on TV begging us to let them sue someone for us and get all that money we're rightly due.

If the FCC swat teams start monitoring 75m there are several infamous nets which will keep them busy. Well, I've given up waiting for our only national organization (which I won't identify here for fear of being accused falsely of ARRL-bashing) to take some shreds of responsibility in this area, but they don't seem to give a hoot what awful things are going on in our ham bands.

I'll have to get a copy of the law and see if the swat teams can confiscate not only the radio equipment being used to create this poisoning of minor minds, but maybe they can confiscate the house and other property too, like they do when someone merely alleges that drugs are on the premises.

Hey, maybe our ham clubs can form vigilante teams to make citizens' arrests of foul-mouthed hams. We should look into that, eh? But let's get busy on this before some well-meaning do-gooders spoil everything by getting the law rescinded.

Positive Action

Here's what the ARRL should have done instead of blustering: They should have used a positive approach instead of a negative one in dealing with the LEO ogre. John Keating WA2FVL has the right idea. He's written to his congressman explaining what is going on. The result was that a Representative who'd voted to sell frequencies now has had a change of heart. Congressmen are dealing with endless bills, many of which they know little about, or have been pressured on by lobbyists. Like the general public, they know almost nothing about amateur radio—much less that there are some agitated voters in their district with a special interest in preserving our frequencies.

Instead of calling the LEO people names we should spend our efforts educating the people who are going to make the bottom line decision: Congress.

Conspiracy

Dagnab it, while I'm suspicious of most of these conspiracy theories that readers write to me about, there is one where capitalism is again biting us where it hurts. The multinational pharmaceutical giants are not just writing the American laws for us to favor their products, now they're at work on a global basis. Well, when you're making the kind of profits they are, why should they think small? Why not influence the UN, the World Health Organization, the FDA, NIH, and other assorted havens for tenured bureaucrats shuffling papers until their pensions kick in?

Not only are these giants in almost total control of our American medical industry, but also the European.

So what are they plotting now? They want to close down the alternative health industry, which is made up of small companies, and thus is vulnerable to giant lobbying power. And that includes vitamins and food supplements, unless they are prescribed by a doctor. Well, that ought to quadruple their cost. Or worse.

Yes, I know that the alternative health industry is in one heck of a mess. They're not allowed to promise health benefits, and the medical industry refuses to test their products, so the public has no way to know what works for what and what doesn't.

I get audio tapes, videos, books and direct mail promotions for endless nostrums. If I got sucked in on all this stuff I'd be spending hundreds of dollars a week and doing who knows what to my body.

Yet, when I read a couple of the medical newsletters that I've come to trust (such as *Second Opinion)* by Douglass (who does not answer his damned mail), I find him extolling the virtues of essiac for people who've misnourished themselves into cancer. Well, the book on essiac is on my list of books you're crazy if you don't read, so I'm pleased to see my opinion confirmed.

Unless you make a fuss over this with your representatives in Congress you're going to get screwed. Again.

CC&R

Read the fine print! If you are moving into any kind of a community you'd better look carefully before you sign that contract. Look for the Covenants, Conditions and Restrictions. And in them, more often than not, you'll find that you are not permitted to put up any kind of an outside antenna.

Talk about ham emasculation! A true-blue ham would prefer a tarpaper shack out in the country to a showpiece house where no antennas are permitted. We hams live and die by our antennas. After all, what's more important, impressing some people (non hams, of course) with how much money you were able to spend on a house, or to have a hellaceous signal? No contest.

Before you move make damned sure you can put up any kind of a tower you want—that you can swing a 40m beam from it if you feel like it. I've always been a 20m person myself. Besides, a 32-foot beam is a lot easier to put up than a 64-foot monster.

Any real ham wouldn't move into a community anyway. That means TVI, angry neighbors, and aggravation. My nearest neighbor is over a half mile away, and I like that just fine.

If you're stuck because of your job in a city or a crowded suburb, isn't it about time to start planning ahead for that ideal QTH? When you're working for someone else you are never going to be really free. Lincoln freed the slaves, but our school system hasn't. It's planned to condition you to shut up, get a job, and work your ass off until you can retire on social security. Retirement used to include a pension which provided enough money for a camper, but the big companies have figured out that downsizing your job a few years before retirement is cheaper.

Okay, I'm a cynic. In my book on making money I explain that you should only work for other people long enough to learn what you need to know to run your own business. And that's maybe two to five years, if you haven't had your motivation gutted by the "system."

Well, anyway, watch out for those CC&R clauses and avoid any community that has 'em in the contract.

If It Ain't Broke

If you consider the federal deficit, and not even counting trillions of dollars in unfunded future mandatory expenses, our country is broke. Okay, so let's fix it. Are you interested in helping? Hmm, I was afraid of that.

Red-Green

In my editorials and in my review guide to books "you're crazy if you don't read" I've asked the readers to let me know of any really important books I may have missed. After all, I've only been able to read a few thousand books out of the millions of titles published, so I need all the help I can get to sort the wheat from the chaff. And, hoo-boy, there sure is a lot of chaff.

Of course it's the same thing with music, which is why I produced over a hundred of my *Adventures In Music* series of CDs, each with the top-rated track from about 15 independently produced CDs. Since the six major music giants make damned sure that you aren't going to hear independent music by investing over $100 million a year in payoffs to radio station music directors, this seemed like a practical way to circumvent the "system."

Getting back to books, I've been very fortunate so far in having the authors of some outstanding books send me copies of their work. The first that comes to mind is *Vibrations* by Owen Lehto, which is a serious *must* read. The second was René's *NASA Mooned America.* I have to admit that I get a chuckle every time I get an angry letter from a reader over my being taken in by René's claiming that our astronots never really went to the moon. Margaret Chaney W8ONS sent me a copy of her *Red World - Green World.* It's a $12 book (incl. s/h) that can make a major difference in your life. Please note, I did not say "might make a difference." Read this book or else.

Even though I've never led you astray with my book recommendations, you still want to know what the book is about before you risk a whopping $12, right? Oh, ye of little faith. Oh, ye big tightwad.

Okay, okay, here's the story. Margaret says our world is divided into two basic categories—which she labels for convenience as red and green. This holds for people, animals, foods, trees, and even rocks. If you are a "red-world" person and eat "green-world" food you're going to suffer the consequences. And vice versa. Yes, she provides a simple test to determine which world you or any food, etc., is in. It's a test anyone can make any time and it is failure proof. It works every time.

Margaret points out that medications fall into the red-green dichotomy too, so if your doctor prescribes a red-world pill for you and you're a green-world person, that's bad news. She points out that twins invariably are split, with one being red-world and the other green. Why nature (God?) came up with this dichotomy we don't know, and it's amazing that no one has noticed this split before. It sure explains why Sherry and I eat different foods. We've often noticed this. When we go to a buffet restaurant we always end up with completely different foods on our plates. At home she fixes her meals and I

Continued on page 53

LETTERS

From the Ham Shack

Thomas M. Miller WA8YKN, Richmond IN. Bioelectrifier Update: I'm glad so many readers enjoyed my article in the May 1996 issue of *73*. There has been a much greater response than I expected, many wanting circuit boards. This caught me by surprise, since the thrust of the article was on how to make the circuit boards! However, I talked with FAR Circuits at the Dayton Hamvention, and they will be selling boards for the Bioelectrifier. Drop them a line at 18N640 Field Court, Dundee IL 60118, or call them at (847) 836-9148.

I had an interesting experience while playing with different frequencies for the Bioelectrifier. When the frequency was around 100 reversals per minute I noticed that my heart rate increased to match it! I did this twice to make sure that it wasn't a fluke. This may not affect everyone else this way—I get a similar effect from caffeine. After that I limited my experiments to lower frequencies, around three seconds per reversal, which seemed to have a very relaxing effect. I recommend changing Cl and C2 from 4.7 µF to 33 µF or more to get the lower frequency limit down into this range. Another minor change I recommend is the addition of a 33k resistor in series with the +36 volt lead from the top battery in the stack. This will protect the optocouplers in case of an accidental short, and has the additional benefit of providing a maximum current limit for the current adjust pot—so you won't jump if you crank it up too high! Radio Shack sells a switch that mounts on the back of their potentiometers. The part number is 271-1740. If you mount this on the current-adjust pot, it will not only save you from having to make another hole, but will ensure that you always turn it on in the lowest current setting. The "aluminum foil" electrodes make a good low-resistance connection over a large area, making it unnecessary to shave the skin and use messy electrode cream, but I've noticed that after a while they get wrinkled, and the creases make "hot spots" that feel like some small critter is nibbling at your ankles! Also, there is some question of aluminum ions migrating into the blood—not a good thing, to be sure, but highly unlikely due to the polarity reversals and very tiny current. I found a pretty good solution to this. At the auto parts store, I found a roll of two-inch-wide stainless steel tape with a peel-off backing. This tape is much heavier and more resistant to wrinkling than standard foil, and it's already preglued. Also, the stainless steel should eliminate any fears of aluminum ions. I put some on two strips of vinyl and added Velcro for a very comfortable set of cuffs. J.C. Whitney also sells this tape. Call them at (312) 431-6102 and order part number 12DF3575U. Of course, the best (if most expensive) material for electrodes is silver. Large medallions containing one ounce of pure silver are available at coin shops for a small premium over the spot price of silver, and should make super electrodes. Silver is a natural antibiotic, with both antibacterial and anti-viral properties.

I hope you will share your experiences with the Bioelectrifier. Remember, this device is an adjustable micro-current source for personal experimentation, and is not intended as a "medical device," nor do we claim that it is a "cure" for anything. At this point, we have virtually no experimental data, so we don't know what effects, if any, it may have. I liked Wayne's idea about using a bioelectric device as a "plant growth stimulator." In fact, I was interested enough to think up some interesting experiments to try along this line. It would be interesting to see if 50 microamps through the moist soil will enhance seed germination. Are these plants different from those that sprouted normally? Another idea is to modulate the DC current with audio! Experiment with different tones, or play music. A small audio amp and an output transformer would provide a means of modulating the 50 microamp current. It's possible that different types of music could have different effects, although I'd avoid anything that sounds like a cat being turned down in a lathe. As long as we're talking weird, how about this? If we were to reverse the transformer, with the 8 ohm winding in series with the 50 microamps, then run the 1k side to the input of the audio amp, with a lN34 diode in series, we just might listen for sounds *from* the plant! How about listening to one plant while playing music to another one across the room? (Now *that's* weird!) The best thing about this is that (as far as I can tell) the plants have no SWAT teams or big lobbies in Congress, so it might be safe to try these experiments! In fact, I've come up with a slightly different circuit and designed a new board to go with it. It's a lot smaller—so much so that it might be hard for some people to build, but I'm willing to sell an assembled circuit board, fully tested, for $38.00 plus $2.00 for postage. I'll even include a potentiometer with a switch and a small terminal block for connecting the electrodes. You will need a small box and some batteries, available from Radio Shack. This circuit puts out the same DC current and reverses polarity just like the original Bioelectrifier. Although it's called a "Plant Stimulator," there may be many possible uses for this device. What you do with it in your own home is, of course, your own business! I'll be happy to hear about your experimental results with these devices, and I'd like to know about any other uses for them that anyone may come up with.

Beck recommends using a couple small electrodes on one wrist instead of the ankle units he first used. Well, for me that makes it a lot easier. I carry the unit in a jacket pocket and am able to type and work while zzzing myself. I use a couple of Velcro-fastened elastic straps on one wrist. There are two arteries, about an inch apart there. I've written about this before. The lower frequency to induce sleep is an interesting approach which should be explored. And certainly the Schuman 7.8 Hz frequency should be explored. I've tried to get you to read Bird's "The Secret Life of Plants" and "Secrets of the Soil." These explain about the incredible impact of music on plants (a.k.a. crops). And I have a video of a plant hooked up to an oscillator, obviously trying to imitate human speech. Why does classical music help plants grow like crazy (some farmers have loudspeakers in their fields), and rock 'n' roll stunt plant growth? And children's too, I suspect. At least mentally... Wayne.

Guy A. Matzinger KB7PNQ, Cheney WA. From my point of view, the ARRL has once again lost an opportunity to truly be the standard-bearer for amateur radio affairs—when that Board of Directors voted to support retaining the *International Morse Code* Treaty *Obligations*, interpreting the results of one more survey with the usual rationale and explanation for their actions. Any suggestions that the survey is representative of the total amateur population as a whole forget that the League's membership is less than 25% of that population, and that about one-third of those members hold Tech and Tech Plus licenses. Interestingly, less than 12% of their members operate exclusively on HF bands, with most using computers and/or keyboards for code communications. On the other hand, their French counterpart—without "rounding up the usual suspects" and with a refreshing display of truth and honesty—acknowledges that code testing is used to filter and limit participation in the hobby.

The ARRL recently asked for comments on their proposed restructuring of amateur licensing requirements—a proposal that appears to be nothing more than small bits of tinkering. Sifting through the chaff, you discover that the suggested changes are not

significant—mostly window-dressing that continues to promote segregation. However, the restructuring strategy implies that steps need to be taken to contain "perceived" abuses of the handicapped waiver provision—does the League mean to challenge the judgment of the medical profession? The proposal also suggests that there are too many amateurs to allow participation on all bands by *all* operators. Is that comment—considering the remarks of media pundits that: "the ARRL represents the *majority* of *operating* amateurs"—an admission that the *majority* of *operators* are incapable of self-controlling band occupancy?

Amateur clubs throughout the country are lamenting the failure of amateurs to upgrade and new operators to join their organizations. The argument they hear, from young and old, against either upgrading or joining *any* organization is, "the benefits are not worth it." The future of the hobby is at risk unless a way is found to attract new blood and stimulate participation in HF communications. The future of HF bands lies with spectrum use by *all* amateurs—perhaps a period of training using all the bands, with an experienced operator, prior to being issued a license would stimulate interest. We are past the point of upgrading and if a creative solution is not found to energize interest in HF operations then, as the aging old-timers fade away, so will those bands and most of amateur radio.

When an autocratic organization initiates legislation that creates preferential benefits, society becomes divided, and sooner or later, those being dominated by special interests will realize that they are being oppressed by manipulated regulations and collaborating bureaucrats—they will seek relief from that discrimination—usually to the detriment of all concerned. This nation was built on the values and principles of individual responsibility and self-determination, not by people who believe they have the right to control others. Tomorrow's technology must be accommodated—standing pat and limiting participation will almost certainly mean death for the hobby.

James Wilkins, Poolesville MD. Recently there was a local newspaper article about a lost hunting dog who took shelter in a cave containing a bear. They survived by not fighting during the emergency. What caught my attention was that the dog was eventually found because he was wearing a radio collar. It seems to me that ham clubs could gain useful publicity, probably gratitude or even occasional monetary gifts if they could sell simple dog-finders in the frequency ranges of their transmitter hunts. There are a lot of cheap crystal oscillators on the market intended for computer clocks, and the frequency selection is extensive. Lost and hungry dogs in rural areas chasing farmers' livestock get shot, with the full approval of the law. This arrangement also would save dog owners from having to buy both a transmitter and a receiver for $500 or so. Hams need a boost in their public image, as well as an outdoor break from the Internet terminal.

The idea of using a ham skill for the public good, or even—gasp—to make some money seems alien. It probably won't fly... Wayne.

Richard Heppert KC4YQL, Kingston TN. Why a filter? A letter from James Hanlon W8KGI in the March issue of *QST* titled *The Best Filter* described CW as the fairest "filter" to prove one's worthiness to use the HF bands. He describes CW as a "skill that is related to the practice of the

Continued on page 61

QRX . . .

Tech Support Has Its Moments...

So you think you're computer illiterate? Check out the following excerpts from a *Wall Street Journal* article by Jim Carlton.

1. Compaq is considering changing the command "press any key" because of the flood of calls asking where the "Any" key is.

2. AST technical support had a caller complaining that her mouse was hard to control with the dust cover on. The "dust cover" turned out to be the plastic bag the mouse was packaged in.

3. Another Compaq technician received a call from a man complaining that the system wouldn't read word processing files from his old diskettes. After troubleshooting for magnets and heat failed to diagnose the problem, it was found that the customer had labeled the diskettes and then rolled them into a typewriter to type the labels.

4. Another AST customer was asked to send a copy of her defective diskettes. A few days later a letter arrived from the customer along with Xeroxed copies of the floppies.

5. A Dell technician advised his customer to put his troubled floppy in the drive and close the door. The customer asked the tech to hold on, and was heard putting the phone down, getting up and crossing the room to close the door to his room.

6. Another Dell customer called to say he couldn't get his computer to fax anything. After 40 minutes of troubleshooting, the technician discovered the man was trying to fax a piece of paper by holding it in front of the monitor screen and hitting the "send" key.

7. Another Dell customer needed help setting up a new program, so a Dell tech suggested he go to the local Egghead. "Yeah, I got me a couple of friends," the customer replied. When told "Egghead" was a software store, the man said "Oh, I thought you meant for me to find a couple of geeks."

8. Yet another Dell customer called to complain that his keyboard no longer worked. He cleaned it by filling his tub with soap and water and soaking the keyboard for a day, then removing all the keys and washing them individually.

9. A Dell technician received a call from a customer who was enraged because his computer had told him he was "bad and an invalid". The tech explained that the computer's "bad command" and "invalid" responses shouldn't be taken personally.

10. An exasperated caller to Dell Computer Tech Support couldn't get her new computer to turn on. After ensuring the computer was plugged in, the technician asked her what happened when she pushed the power button. Her response: "I pushed and pushed on the foot pedal and nothing happens." The "foot pedal" turned out to be the computer's mouse.

True story from a Novell NetWire sysop:

Caller: "Hello, is this tech support?"

Tech: "Yes, it is, how may I help you?"

Caller: "The cup holder on my PC is broken and I am within my warranty period. How do I go about getting that fixed?"

Tech: "I'm sorry, but did you say a cup holder?"

Caller: "Yes, it's attached to the front of my computer."

Tech: "Please excuse me if I seem a bit stumped; it's because I am. Did you receive this as part of a promotional, at a trade show? How did you get this cup holder? Does it have any trademark on it?"

Caller: "It came with my computer, I don't know anything about a promotional. It just has a '4X' on it."

At this point, the tech rep had to mute the caller, because he couldn't stand it. The caller had been using the load drawer of the CD-ROM drive as a cup holder and had snapped it off the drive!

Taken from the *Elk County ARA Newsletter*, Vol. 6.3, which may or may not have been the first to borrow it from the *Wall Street Journal.*

Red Cross Calls on DARA for Help

The weekend of March 8th, 1997, the DARA van was dispatched to Cincinnati, Ohio, to assist the Cincinnati Red Cross with damage assessment activities in and around the City of Cincinnati. This callout was due to the worst flooding on the Ohio River in the past 30 years. The initial call came at about 10 a.m. on Friday when Emergency Coordinator Ernie Hudson KI8O notified Van Chairman John Phillips N8ZGT that the van was needed in Cincinnati. Plans were immediately put into action to alert the necessary personnel.

Early Saturday morning the van left the Bellefontaine Road site en route to the Red Cross Chapter in Cincinnati. After a briefing session, the van was deployed to Pendleton County, Kentucky, about 50 miles from Cincinnati. The van set up operations at Pendleton County High School. The van was to pass traffic from the Damage Assessment Teams to the Cincinnati Red Cross Emergency Operations Center. The Red Cross had 60 Damage Assessment Teams in the flooded area. They could not communicate with the EOC due to terrain and limited radio capabilities. The van was able to relay traffic to the EOC without difficulties.

The van and its crew remained in Cincinnati overnight Saturday. On Sunday morning the crew was dispatched to the Red Cross Shelter in Brookville, Kentucky, in Bracken County, farther east from the previous day's location. The Damage Assessment Teams were surveying the area northeast of Brookville, near the city of Milford. Sunday afternoon the van was relocated to Augusta, Kentucky. In Augusta, the van crew repeatedly saw extensive damage from flood waters. There were several structures more than a hundred years old that were heavily damaged by the flood. Several mobile homes were washed off their sites; all that remained was gravel and pipes sticking from the ground. The front porches from the mobile homes were located several blocks from the original sites. Everything was covered with mud and soaked with foul-smelling water. Several of the Damage Assessment Teams reported seeing only the roofs of buildings above the flooded areas.

The van continuously operated on three or four VHF and UHF frequencies, maintaining communications with the Cincinnati EOC and stations in Dayton. The stations in Dayton were prepared to assemble relief operators if the situation warranted. Also several of theDamage Assessment Teams could communicate with stations in Dayton only via the FARA 145.19 MHz repeater system. The van relied on relay traffic from the stations monitoring the 145.19 FARA system.

While the van and its crew were operating on the Kentucky side of the Ohio River, more amateur operators were busy on the Ohio side. Many

amateur operators assisted with the disaster relief operations in Ohio, Kentucky, Indiana, and Illinois.

Here are personal observations from Ron Moorefield W8ILC, D.E.C., and Ernie Hudson KI8O, E.C. Mont. Co.

"This is a summary of the Ohio River Flood and what DARA and the DARA van did on March 8-9.

"The US Weather Bureau said that this was a once-in-a-thousand-year event, especially in areas in southern Ohio and northern Kentucky along the Ohio River.

"When the DARA van was requested to support the American Red Cross Damage Assessment Teams, we saw firsthand what the force of water can do to many small communities.

"We not only supported the Red Cross near Falmouth, Kentucky, Bracken County and Augusta, Kentucky, but offered support to the Kentucky National Guard, Civil Air Patrol, and the Kentucky State Police. It was amazing that the Guard's satellite systems could not see the satellite, so we offered support to them. Also, we had to program the radios for the Civil Air Patrol.

"ARES ID cards are very important and need to be worn. These cards are usually the only thing that will allow you to cross police barriers. If you do not have an ARES ID card, please contact Ron Moorefield W8ILC.

"DARA stations that spent time in Kentucky were: N8XGA, KB8RTD, KC8AVU, W8ILC, N8UFN, KA8GOV, KB8YDS, N8ZGT, KB8PMV, N8JBL, K8QZN, N8HSU, N8TFD, N8UCL, and N3TNQ. Stations that were at the State EOC in Columbus were WD8DLQ and W8RLY. The stations that supported us in Dayton on the FARA 145.19 repeater were: N8VET, N8VVZ, KI8O, KA8OKC, N8VZV, and N8MYQ. Many thanks to the FARA Repeater Group for seeing that the frequency was clear when we needed it.

"The frequencies used in the disaster area were 147.42 simplex, 147.375 repeater to the Cincinnati Red Cross and the 444.9 repeater to the Red Cross as well as the 145.19 repeater for support.

"Again, many thanks for a job well done. The Red Cross indicated that without the amateur communications, the job would have taken a couple of weeks to complete and we did it in two days."

From *RF-Carrier*, monthly publication of the Dayton Amateur Radio Association, April, 1997.

Introducing the Family Radio Service

The FCC created the Family Radio Service back on May 10, 1996, but I've never seen any details about this new unlicensed radio service in *QST*. Why should hams care about a short-range unlicensed radio service closely related to CB radio? Two reasons: (1) over 99% of the people in this country are not licensed radio amateurs and (2) it is illegal to use amateur radio for business communications. Small hand-held transceivers for the Family Radio Service could be used to keep in touch with unlicensed family members or for conversations one couldn't legally conduct via amateur radio. In addition, Family Radio Service transceivers should be relatively cheap, probably about $100.

A total of 14 channels are assigned for the Family Radio Service. These 14 channel frequencies are listed below.

Channel No.	Freq. (MHz)
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	467.5625
9	467.5875
10	467.6125
11	467.6375
12	467.6625
13	467.6875
14	467.7125

Alert readers will recognize that the first seven frequencies on this list are shared with the General Mobile Radio Service, a licensed radio service that allows a license holder to use up to 5 watts on these seven frequencies, and up to 50 watts on two of eight available repeater frequency pairs. The GMRS repeater frequencies are 12.5 kHz on either side of the frequencies on this list. So why don't people just get a GMRS license instead? Getting a GMRS license involves filling out several pages of FCC forms and paying a $60 license fee.

In an effort to prevent the Family Radio Service users from interfering with GMRS and each other, the FCC imposed fairly tough technical requirements on the transceivers. These technical requirements follow.

Transmitter Power: 0.5 watts ERP
Modulation: FM, 2.5 kHz deviation
Antenna: Integral to unit (no connector)
Frequency Accuracy: 2.5 ppm (0.00025%)

I believe that the first, second, and last items on this list prove that Motorola's lobbyists are smarter than both the FCC lawyers and lobbyists for GMRS interests. Cobra and Uniden America favored somewhat looser standards, but Motorola argued for 2.5 ppm frequency accuracy and 2.5 kHz frequency deviation, standards which require more engineering skill to meet. The reduced frequency deviation and 2.5 ppm frequency stability requirements will tend to keep the Chinese "us too, but cheaper" manufacturers of cordless phones and CB radios out of this market. Motorola also argued for a "tougher" 0.5 watt ERP (effective radiated power) power limit in place of 0.5 watts at the transmitter output to help protect GMRS users from interference. However, considering how inefficient most HT antennas are, I think 0.5 watt ERP is actually a power increase over the 0.5 watt transmitter power the FCC originally proposed.

Anyone wanting more information on the Family Radio Service can go to the source for this article, FCC Docket 96-215. FCC rules for the Family Radio Service are in Part 95.

By George Bednekoff KAØOCN, *PARKing Ticket*, October 1996.

Top 10 Pleasures of Field Day:

10. Fishing bugs out of your coffee cup.

9. Getting lost on the way to the porta-potty.

8. Tripping over guy wires and tent ropes in the dark.

7. Discovering that your three-element wire beam for 40 meters, which took all day Friday to erect, is oriented in the wrong direction.

6. Fixing a broken paddle with duct tape.

5. Finding out what happens to a tribander when you drop it from the top of the tower.

4. Having to choose between Field Day operation and your wedding anniversary.

3. The "food."

2. Explaining to your XYL that the YL ops are "just hams."

And the Number 1 Pleasure of Field Day:

1. Getting in the truck to go home and finding that someone has borrowed your battery.

TNX *The Low Down*, the official journal of the Colorado QRP Society.

Number 10 on your Feedback card

Getting a Taste of VHF

Test drive the bands before you invest in the equipment.

Philip Gebhardt VA3ACK
40 Cameron St.
Ajax ON Canada L1T 2W2
[102515.2604@compuserve.com]

Everyone hesitates to spend a lot of money without first making sure it will be worth it. When you shop for a washer and dryer, you compare features and prices. When you buy a car, you take it for a test drive.

Wouldn't it be nice if you could "test drive" the VHF bands before you invest time and money in the ham radio equipment you'll need to do some serious VHF DXing? That way you could decide if VHF DXing is for you—without making a commitment. You can. Here's how.

The common forms of VHF DX propagation—tropo, sporadic E, meteor scatter and aurora (and F-layer propagation at the peak of the solar cycle)—are not limited to the ham bands. Any VHF signal will be affected by these modes.

And that's what you can capitalize on. Instead of investing money in ham radio equipment to try out these bands, use what you already have. What do you already have on the VHF bands? An FM broadcast receiver and a television set, of course. If you have an outdoor FM/TV antenna, you're in really good shape. A rotor on your antenna is even better—but even without these things, you can get a start on VHF. It's not uncommon to hear VHF DX on an FM car radio.

Many FM (and TV) broadcast stations operate 24 hours a day. Transmitter power is usually in the 25, 50 or 100 kW range. Fortunately, the stations are scattered all over the continent. So, if there's an opening on VHF, you'll hear (and see) these stations.

It's a matter of knowing where and when to listen.

Where?

The "where" part is relatively easy and straightforward. Since the lower VHF TV channels are close to the 6-meter ham band, they are a good choice. (Channel 2 spans the 54 to 60 MHz range; channel 6 occupies 82 to 88 MHz.) Generally, choose the lowest unused channel in your area. If your antenna is rotatable, you may be able to point it away from a semi-local station and create a usable channel.

The FM broadcast band is farther from the 6-meter ham band, but you will still hear the same types of VHF

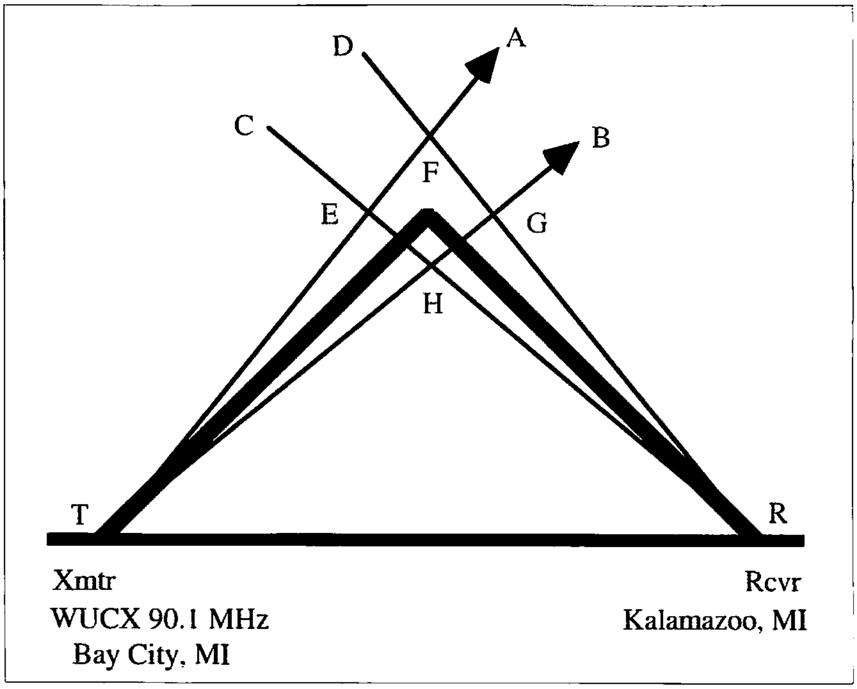


Fig. 1. Reception distance is often increased by tropospheric effects. Scattering from a common area of the sky is only one way this happens. As in other forms of VHF (and HF propagation), the antenna is aimed at the horizon, not pointed upward. The antenna beam is sufficiently large to detect signals coming in at an angle. In this diagram, the width of the beam from the transmitting antenna at WUCX in Bay City is shown by rays TA and TB. The receiving antenna in Kalamazoo "sees" the portion of the sky bounded by line segments RC and RD. The beams of the two antennas overlap in the region EFGH. If there is an anomaly in this region, signal from the FM station will be scattered and returned to Earth. The heavy line shows the path of a signal being scattered and received in Kalamazoo.

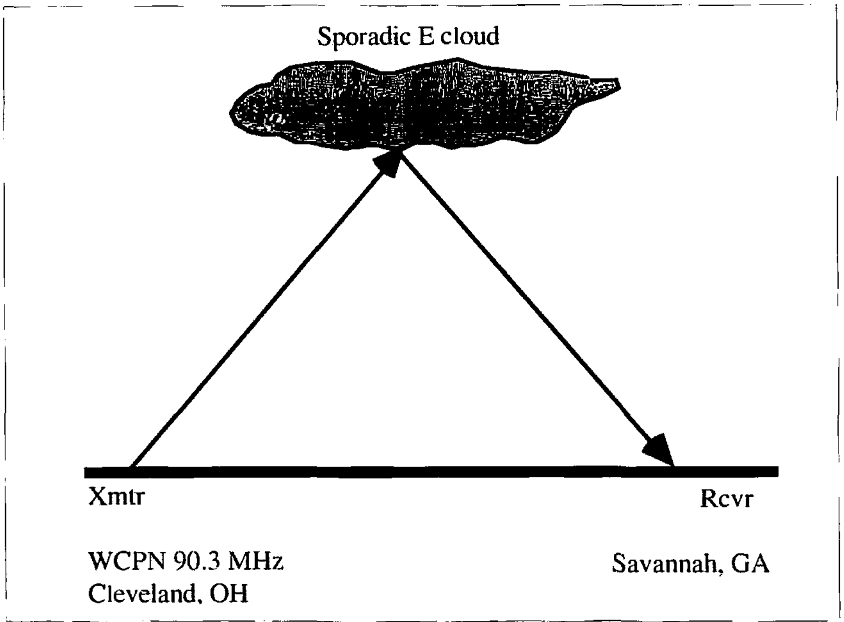


Fig. 2. Signals are reflected by ionized clouds in the E layer of the ionosphere. Sporadic E signals are strong and may last much longer than meteor scatter signals.

propagation. There are plenty of tropo, sporadic E and meteor scatter signals to hear on the FM band.

Choose an unoccupied frequency in the FM band for best results. The lower portion of the FM band is occupied mainly by educational and noncommercial stations. Although they may run lower power than the commercial stations higher up, they may cause you fewer interference problems and you may hear a variety of stations come and go on a single frequency as propagation changes.

You will sometimes hear (or see) DX override a semi-local station or even a local station.

Why an unoccupied frequency? Simply because it is easier to detect weak signals that could easily be masked by a stronger station. Also, it's easier to hear a weak signal if there is nothing but noise competing for your listening attention.

It's easy to select an unoccupied TV channel, but there are several things to keep in mind when selecting an FM frequency. Remember that although the FM band covers the 88 to 108 MHz range, the lowest assigned frequency is 88.1 MHz; the highest frequency is 107.9 MHz. Stations on the FM band are spaced at 200 kHz intervals, so assigned frequencies follow the pattern 88.1, 88.3, 88.5, and so on. There are no stations on frequencies such as 88.2, or 88.25 MHz. A receiver with a digital readout makes it much easier to "park" on an unoccupied frequency. If your receiver has a rule-and-pointer dial, you'll need to estimate the frequency.

If you live in a metropolitan area, finding an unoccupied FM frequency can be a challenge. In that case, the best you may be able to do is to listen on frequencies where signals are weak.

If you are blessed with a QTH where you have a multitude of unoccupied frequencies, you'll need to make a decision about where to listen.

You can use several approaches to solve this "problem" (we all should be so lucky as to have it). You can try the hit-and-miss approach: Just pick an unoccupied frequency and listen.

Another approach is to select your listening frequency based on conditions. (This statement will make more sense after the description later on of different propagation modes.) For this you'll need a reference guide such as *FM Atlas*. This annual publication lists FM stations by frequency and by location. It also indicates transmitter power. Knowing transmitter power allows you to select the higher-power, easier-to-hear stations. Transmitter antenna height (also listed) can sometimes be an advantage to know, too.

That covers the basics of where to listen.

Now for the "when" part

"When" is generally dictated by propagation. Many books go into great detail about the various forms of propagation on the VHF bands. You'll also find some excellent articles by looking through back issues of ham radio periodicals (such as *73*). Here

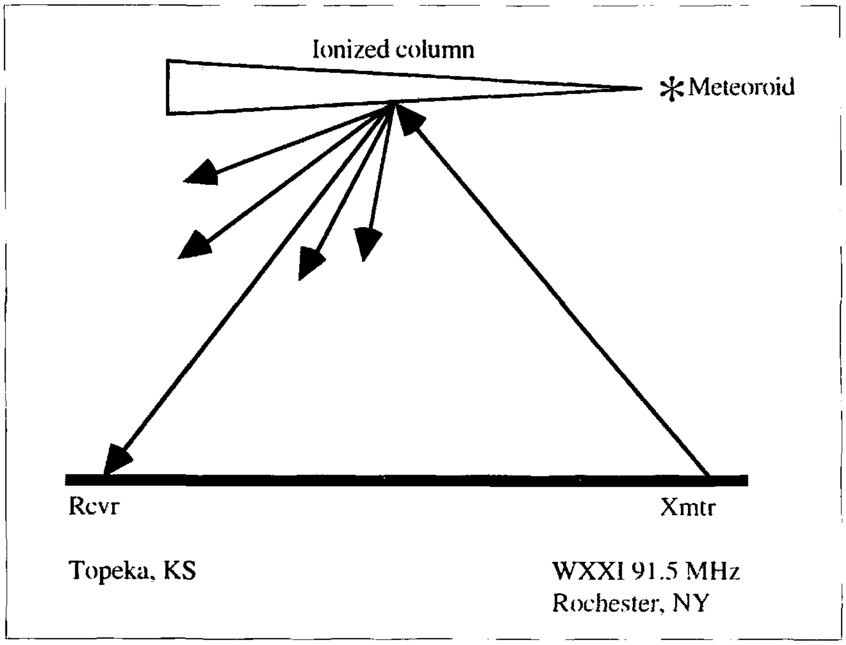


Fig. 3. Signals are reflected by ionized meteor trails. In most cases, however, the signals are scattered rather than reflected in the general sense of the term. The density of the trail governs the reflection vs. scattering effect.

are some basics to give you an idea of when to listen and what you are listening for.

Tropo

There are a number of effects within the troposphere that enhance signal propagation. While the common belief is that signals are limited to line-of-sight range at VHF, this is rarely the case with a beam antenna on a tower. Listen to the FM band and record the stations you hear. It won't take long to realize that many of them are well beyond the line of sight. This in itself is a good lesson in VHF propagation (if you don't know how to calculate the distance to the horizon, check the propagation chapter of the *ARRL Handbook* for the formula).

Stations can be heard almost daily using tropo scatter. Both antennas are aimed at a common area in the troposphere. The lower boundary of the area is determined by the antennas in use; the upper boundary is about 10 km (6 miles) above Earth's surface. That's not very high, so signals are limited to about 500 km (300 miles) between the FM station and your antenna. In practice, the distance is usually much shorter than this.

What makes this form of propagation so appealing is its dependability. There is little day-to-day or seasonal variation. If you live near a large body of water—the Great Lakes, the Atlantic Ocean, the Pacific Ocean or the Gulf of Mexico—you can take advantage of temperature inversions. These occur from the evening until the morning hours.

Weather maps in newspapers, on TV or (these days) available on-line via your computer give clues to propagation. Watch for a warm front approaching your area. Propagation is parallel to the front and occurs for several hundred kilometers ahead of the front. Cold fronts also enhance VHF propagation along the front. In this case, the signals propagate behind the cold front. Start listening just after the front has passed your QTH.

Wave cyclones occur in the spring over mid-America and may provide propagation for a day for stations in the northern, southern, eastern and central states.

Slow-moving high-pressure systems, common in late summer over the eastern half of North America, can provide DX possibilities during the evening and early morning hours. Refer to ARRL publications, such as *The Radio Amateur's Handbook* or *Beyond Line of Sight*, for more details.

As mentioned previously, this is a time when you would want to use an FM station guide to select specific stations to listen for. Why waste time listening on 90.7 MHz during an opening along a warm front, if there are no stations within a few hundred kilometers ahead of the front operating on 90.7 MHz?

Sporadic E

You'll see this form of propagation also referred to as E skip, short skip or Es. The term "sporadic E" comes from the fact that the DX openings are sporadic (and therefore not predictable) and that the ionized clouds responsible for reflecting signals are located in the ionosphere's E layer.

In any case, sporadic E occurs most frequently in May, June and July and to a lesser extent in December and January. Listen from 9:00 a.m. to 12:00 p.m. local time and again from 5:00 p.m. to 8:00 p.m. These are the most common listening times; however, sporadic E can occur at any time of the day or year. The opening may last anywhere from a few minutes to several hours.

Because the clouds form suddenly, signals appear quickly. Signal strength is high. The clouds may also *move* quickly so one strong DX signal may rapidly be replaced by another equally strong signal from a different station.

Because of the increased altitude, sporadic E signals have a greater range than tropo signals. Expect distances from 500 to 2300 km (300 to 1400 miles).

An excellent report on an eleven-year study of sporadic E on the FM band appeared in *QST* (May 1992).

Meteor scatter

Yes, those things you see streaking across the dark night sky affect radio waves. The reason is simple: Not only does a meteoroid produce a visible meteor (trail of light) as it enters Earth's atmosphere, it also produces an ionized column.

This column, like the ionosphere, can reflect signals. How effectively signals are reflected depends on the density of

Shower Name	Peak Date (1997)	Peak Time (UTC)	Duration (in days)	Meteor Rate (per hour)
Eta Aquarids	May 4	2200	6	20
Arietids	June 7	0911	2	60
Perseids	August 12	1800	4.6	100
Orionids	October 22	0100	8	25
Taurids	November 5	0124	30	15
Leonids	November 17	1052	4	15
Geminids	December 14	0600	3	58
Ursids	December 22	1145	2.2	10

Table 1. Data for various showers of interest to amateurs. Each shower lasts for several days, so listen before and after the peak date. The column labeled "Duration" gives an indication of how many days you should listen.

the column. About ninety percent of meteor trails are underdense. Underdense trails tend to scatter the signal, hence the term "meteor scatter."

You can hear meteor scatter any time of the day or night and on any day of the year. There is a diurnal variation with a maximum occurring around 6:00 a.m. local time and a minimum occurring at 6:00 p.m. The ratio of maximum to minimum is about 4 to 1. You may hear a few to a few dozen per hour around 6:00 a.m. This is the pattern for sporadic meteors (meteors produced by meteoroids that travel alone).

Since both the time of arrival and direction of sporadic meteors is unpredictable, you can simply point your antenna south in the morning, select an unoccupied frequency and listen.

At predictable times throughout the year, you can hear an increase in the number of reflected signals. This occurs during meteor showers. Probably the most famous shower is the Perseid shower that occurs in August. During a meteor shower, Earth passes through a large number of meteoroids traveling in highly correlated orbits. Depending on the shower (and your listening setup, of course), you can hear several dozen to several hundred signal reflections per hour. There are even daytime showers that can only be detected by radio means.

"It's a matter of knowing where and when to listen."

Refer to an annual astronomy book (such as Royal Astronomical Society of Canada's *Observer's Handbook*) or a periodical (*Sky & Telescope* and *Astronomy* are available at newsstands) to find the dates for showers. **Table 1** will get you started.

Timing and antenna direction are more critical with showers than with sporadic meteors. You can try the probe method (listening for signals to peak as you rotate the antenna—not very effective in this application), or you can read the VHF manuals for hints. Computer programs are available to calculate peak times and corresponding antenna directions. Check your favorite ham radio BBS or on-line service.

You might think that you need to point your antenna upwards. That is not the case. Point your antenna at the horizon to hear signals reflected by meteors. This approach will yield the greatest distance.

Because meteoroids ablate at an altitude comparable to the E layer of the ionosphere, distances will be comparable to sporadic E signals.

Now, for what you'll hear: Assuming that you are listening on an unoccupied frequency, most of the time you'll hear mainly receiver noise. Periodically, you'll hear a signal rise out of the noise very rapidly. As soon as it peaks, the amplitude will start to decrease. The signal may last for a fraction of a second or for several seconds depending on the meteor. There may also be a residual signal beyond this time.

That's it, folks

No station IDs, no complete songs, no entire weather forecasts. You'll be lucky to hear a few notes of a song or a few syllables (maybe words) of a news report.

Why do people put themselves through this agony? Sporadic meteors are basically practice. The real fun comes during meteor showers because there are so many more meteors. During a shower, you hope for several meteoroids coming into the atmosphere in succession so the signal lasts longer as it reflects off successive meteor trails.

The advent of computers and the use of packet techniques by hams makes signal exchanges much faster (and therefore more successful) than previously possible. So, if you like listening to meteor scatter on the FM band, you'll probably really get excited when you hear it on the ham bands.

Aurora

Signals can also reflect off the aurora. However, the number of opportunities you have to use this form of propagation depends on your latitude. The farther north you are, the more opportunities you get—but it's a little more complicated than that. Auroral propagation depends on geomagnetic latitude. Rather than following those neat lines of latitude that appear on maps, geomagnetic lines slope from

northwest down to southeast. As a result, DXers on the east coast have an advantage.

Auroral propagation is cyclic. There is a seasonal pattern with more opportunities at the equinoxes (March and September). There is also a cycle that may be related to, but not in phase with, the solar cycle. Peaks occur about 2 years before and after the solar cycle maximum. The diurnal pattern indicates two strong peaks—one at about 6:00 p.m. local time and a second around midnight.

Best signals are heard by pointing your antenna in a northerly direction, but probing for the best signal is important.

Predicting auroral conditions on VHF is a matter of listening for the signs on lower frequencies and waiting for the effect to reach the VHF range. Wavering signals that are weak and sound watery on the AM broadcast band up through the 40-meter band in late afternoon or early evening are a sign that auroral conditions are developing. Station WWV broadcasts A and K indices at 18 minutes past the hour; WWVH does the same at 45 minutes past the hour. A K index greater than 5 and an A index greater than 30 indicate that it's time to listen for auroral activity.

Keep in mind that you may not see the aurora, but you may still be able to hear signals via this form of propagation.

This is only the beginning. There are other forms of VHF propagation as well as variations on the ones mentioned here and even combinations, such as auroral E.

If you find that VHF DXing on the FM broadcast band has whetted your appetite, you are a prime candidate for DXing on the VHF ham bands.

By the way, most of the forms of propagation present on VHF also occur on 10 meters. Yes, you can use your HF rig to have sporadic E QSOs; try your hand at meteor scatter work; and make contacts via the aurora. While sporadic E is exploited on this band, meteor scatter and auroral propagation go virtually unnoticed. You will need to pursue these openings with a like-minded ham.

All things considered, DXing on the FM broadcast band (or low VHF channel TV) is an excellent introduction to the world of VHF.

Horsetrading on the Ham Bands

The FCC has approved on-the-air buying, selling and swapping ham gear via the traders' nets.

Ronald Lumachi WB2CQM
73 Bay 26th Street
Brooklyn NY 11214
E-mail: WB2CQM@Juno.Com

Only a short while back it was really a pain to advertise amateur radio gear for sale or to draft the text of an advertisement for an item that you wanted. You had to write the ad, send it along to your favorite media source, and then wait weeks (sometimes months) before it finally arrived in print. By that time, the event was somewhat anticlimactic—often if an individual did call in response to your advertisement, you'd have to be reminded about the details. Hams, being an impatient (but most resourceful and proactive) lot, recognized the shortcomings of this process and began meeting in their on-the-air cliques to discuss what they wanted to buy, sell, or swap. Increasingly popular, these informal groups evolved into more structured, regularly scheduled occasions, attracting larger and larger numbers of participants. Although the nets sport a variety of names, including Horse Traders, Old Gear & Junk, Collins Net, etc., they all afford the radio amateur the opportunity to offer his/her wares on the air, without delay, to a large number of knowledgeable, attentive, and motivated buyers and sellers—and the best thing about it is that the free service is instantaneous. If it sounds like a good deal, it is. Its success can be traced to the tireless efforts of the radio amateurs who are the net controllers. Their unselfish dedication and perseverance make the service possible.

How does the net work?

The organizational rules are simple and straightforward and are generally applicable to any of the traders' groups. Usually when the net is called, the controller briefly reviews the regulations governing its operation. The FCC has allowed hams to advertise over the air provided they meet minimum criteria. [See Part 97.113 (a) (2) of the Regulations for prohibitions and exceptions to the sale/trade rule.] Obviously, the controllers are in the best position to enforce the regulations to the letter of the law since the FCC, because of its manpower and budget shortfalls, has of necessity directed its attention to more pressing matters.

The first and most important admonition is that commercial advertisers are not welcomed. In addition, anyone who has been identified and proven to be (to the satisfaction of the controller) a full-time purveyor of radio gear is told he/she is in the wrong place and asked politely to move on. Third party listings are not permitted but their wants are OK. Any equipment offered must be in the seller's possession. This situation arises frequently when there is an estate sale and a ham, as a special favor to the widow, offers to liquidate the gear. If that's the case, it's easy to conform to both the spirit and letter of the law: Have the gear in the shack when advertising. Net controllers are aware that FCC regulations allow on-the-air sale or trade of any equipment provided it is ham-radio-related. They make a conscientious effort to conform closely to that ruling. To illustrate this point, I recall in one instance an individual offered an aviation-type GPS (satellite positioning) unit and an altimeter, ostensibly to locate and accurately measure the height of one's QTH. He was politely reminded that offering that equipment was stretching the rule a bit too far and was politely directed to hit the road! Computers are accepted on the general equipment nets provided they support some aspect of packet operation. Oddly enough, scanners can be listed with impunity.

A seller may quote a price for an item, but any negotiations, haggling, or plain horsetrading must be accomplished over the telephone. On many occasions, the seller may be asked by someone (through the controller by signaling with the word "contact" and being recognized) to clarify the listing with additional details that may have been omitted. For example, before placing a long distance telephone call, an individual may want to know the serial number of the rig, the number of filters in a particular receiver, or whether the linear is a two-holer or capable of tuning 160m. It's the seller's option to include or omit the asking price. He may prefer to discuss the details more privately over the telephone. One experienced trader mentioned to me that he never calls when a price is not listed. He claims they are invariably too high. If you think it's a worthwhile deal or you need more specific information, make the call. It's important to remember that the nets are "directed," so all inquiries must be channeled through the net controller. Imagine the resulting chaos if it weren't handled in this manner. The controller's task is difficult, to say the least, and virtually impossible to undertake without a first-class radio station, a high degree of personal fortitude, the patience of a saint, and the endurance of a marathon runner. The majority of net controllers maintain a running log of those checking in, including telephone numbers and equipment offered. Some, less technological than others, use their own special

shorthand and keep paper notebooks to record the entries. Others use computers and maintain databases from week to week. Net controllers are routinely asked to search out a previous listing (usually with success) based on very sketchy information. They do it gladly and pride themselves on the sophistication of their logging systems. Most frequently, telephone numbers are incorrectly copied by prospective purchasers (QRM, QRN, QSB) and when queried the controller has the capability to check back into the log and set the record straight. It's not an easy task by any stretch of the imagination, especially when 100+ hams check in with 400–500 bits of discrete information.

How do you participate?

Check the accompanying listing for the net time and frequency that offers you the most consistent propagation. Bands are often noisy and crowded, so listen to those groups that produce the best signal strength to your locale. Interference is often generated in unusual ways. For example, (although it's difficult to explain the motivation) there are occasional incidents of malicious interference from QRMers whose sole purpose is to disrupt the net. Controllers continually remind net participants that they should not get bent out of shape and feed into those guys by acknowledging their presence with speculations about their mental health or family lineage. Past experiences have shown that this passive response works well since those interfering usually get tired and simply fade away. To a lesser extent, overzealous contesters must be continually directed away from the frequency; they usually respond with a quick apology to the controller and an immediate QSY.

Most nets begin promptly and follow a sign-in protocol. Generally, the net controller will accept the suffix of your call in alphabetical order usually beginning with "A." For example, in my instance, I would sign in when the "C"s are called with "CQM." If the controller copied my signal he would acknowledge that I was on the list; if not, I'd try again. If my signal were marginal due to poor propagation to the controller's QTH, I'd ask for a relay. Someone would hear my request and offer to forward the message. Incidentally, mobiles get first

crack at listings. Remember the cardinal rule—*You've got to be on the list to participate!* The hams with the suffix "A" are not always the first to go. Controllers reverse the alphabetical listings weekly. If "A"s were first last week, they're last the next time around. It's the amateur with a callsign in the center of the alphabet who never gets to the head of the line, but there are seldom complaints from anyone. Imagine the confusion if you started at the middle of the alphabet and worked in both directions. On many occasions, the controllers, prior to taking the regular listing, will liven up the sign-in period by calling for a pileup and listening for the loudest station. It's truly organized chaos, but if your callsign is recognized above the cacophony of signals, it's quite an ego trip for the participant. I'll wager there aren't too many hams around who don't want the world to know that they're top banana. It's good fun and enjoyed by all. As a reward for the outstanding five or six of the best signals, the big guns are allowed to list first. It's a small enough compensation for tweaking that antenna, cranking up (sometimes a little above the legal limit) the amplifier, and consuming a bit more electricity. It's an interesting side note but many of the big boys with giant signals accept the accolades and then politely pass on the option to list. They just revel in the recognition and ego-boosting action.

In many cases, the net controller can gauge the length of the net by the number of check-ins. If the list of participants is overly long, it may be decided to limit each trader to a specific number of items. Usually it's never less than four (any combination of buy/sells). If the list appears to be shorter than usual, he may announce that time will be allotted at the completion of the net for latecomers. Pay particular attention for that announcement in the event you arrived too late and the controller has passed you in the alphabet. You'll only get one shot at logging on.

For a variety of reasons, it's a good idea to listen closely to the net rather than become preoccupied at the other end of the house. First and foremost, you won't miss your turn. While listening, you may locate a particular item being offered that is of interest to you. This is especially true if you planned to list a "want" and the item fortuitously appears. More importantly, when you're focused on the listings, you begin to get a feel for the going price of a particular piece of gear. Remember that the "educated" ham will neither pay too much nor ask too little for equipment, provided he/she has done the homework. If you listen for only a short time, you're certain to get the rhythm of the net.

When your turn comes, sign on with your full callsign, handle, and referenced location if you do not live in a city with a recognizable name. In my instance, Greentown (my second station) would have little impact on anyone (except a local amateur, the deer, and perhaps the resident chipmunk) until I indicated that it is situated in northeast Pennsylvania, 20 miles east of Scranton. Because of the high profile of the Big Apple, there should be no problem of location if I'm listing from my (primary) New York City QTH.

"A full-time purveyor of radio gear is told he is in the wrong place and asked politely to move on."

State the items you have for sale (or announce your needs) and be as comprehensive and honest as you can be with this description. Generally, the 1–10 scale is used to evoke an image of condition. For example, a 9+ with a minor scratch on the top cover would indicate that it's close to factory condition but has a surface blemish. Make certain to include all accessory items that will affect the price. For example, what is the serial number? Are there extra crystal filters for the receiver? Do you have the original manual and shipping cartons? Does it include the power supply? Is there an auto antenna tuner? Is there full output on the linear? Are there any spares? Will you ship the item, and does the price include shipping? Does the speaker have a built-in phone patch? Or, with heavy items, would you travel a reasonable distance to meet someone?

Don't be reluctant to advertise a junker, but make certain that you clearly identify what you're offering. Many hams need discrete parts for a restoration or rebuilding project, and what you offer may fit their needs perfectly. To ensure that you've made your list both complete and comprehensible, write down the text of the ad beforehand. Don't try to ad lib. You'll either stumble along and embarrass yourself or leave out a vital part of your message. You'll kick yourself afterwards when you realize why the telephone hasn't rung. It happens all the time, even to the most confident trader. You may, if you wish, state an asking price and indicate if you are amenable to trading for a specific item. If you feel that the trades are not of comparable value, don't hesitate to mention that you are aware of the price difference and willing to offer (or take) an appropriate amount of cash to smooth out any rough spots.

Make a conscientious effort to avoid extraneous comments. Stay focused and leave the chit-chat for another time. Sellers make this mistake all the time. It takes up valuable net time, obscures the message, and generally confuses everyone. Above all, avoid trying to hustle the group by overpricing. Rest assured, the traders know what an item is worth and they don't want to pay for your emotional attachment. You'll know exactly what I mean when you hear a symphony of polite whistles in response to an unrealistic asking price. If that happens to you, you're usually dead meat! Keep to your script and sign out by listing your telephone number twice (slowly) along with the area code, repeating your name phonetically, and listing your callsign. At this point you may offer your E-mail address to those who would prefer to contact you that way.

If you've struck a chord with someone in the listening audience (a hot item at the fair price), expect a telephone call even before you sign off with the net controller. Be prepared for bargaining, but if you've done your homework you're aware of fair value. Feel free to be firm on the price and to reject any unrealistic offer. On the other hand, remember that everyone loves a bargain, so if you're close in price, consider compromising a bit and making the deal. If there's no meeting of the minds, take the caller's telephone number in the event you later

determine that the offer at hand is the best (or only) one received. It's amazing how much better an offer looks when no one else calls. If you've struck a deal, then serious talk should begin. I'd suggest you ask for payment in the form of a postal money order or send the items COD and specify payment to be made in cash. This will eliminate any surprises down the road. It's common practice and not a disagreeable or expensive method to close a deal. Don't forget to jot down the name of the person, callsign, and the telephone number. You may find it necessary to contact that individual at a later date.

If it sounds like a done deal, look for shipping cartons (liquor stores are a good source) and some good packing material during that period when the check is in transit. It's always a good idea to double-pack the component using two containers. Shipping companies are notorious for damaging equipment, so you've got to make it as difficult as possible for them to destroy your treasure. If you are thinking about shipping used equipment with Uncle Sam, keep in mind that the post office usually does not pay off on insurance claims without a battle. Get back on the net to announce your deal as soon as you hang up the phone. Many controllers encourage "rechecks" from sellers to announce that a sale has been made. They will delete the sold item from their computer or simply cross it off. A recheck can also mean someone saves a long distance call. However, if you do happen to get that extra inquiry, take the name and number for reference. On occasion, the money simply never materializes and the buyer doesn't have the courtesy to telephone about the change of heart—so don't hesitate to call the second interested party and make your deal.

What's it worth?

If you haven't spent too much time on the net, it's sometimes difficult to determine what to charge (or what to pay) for a piece of gear. Listen around a bit and hear what's being offered, at what price, or contact one of the controllers prior to the net and ask the going rate for a particular item. Their response, based on experience, is usually on target with prices. If the item you're offering is current production and in mint condition, figure on about 50–60% of the manufacturer's list price as a good starting point. Prices must be adjusted downward if it has flaws and is not up to factory specs. All bets are off if it's an antique and in high demand. Just try to buy a set of original CW and AM filters or a speaker for a Collins 75A4! These discrete components, available a short time back for peanuts, now cost almost as much as the receiver itself. In any event, you'll want the best deal you can get, so if you're not certain, check around. Ask around both before and after the net for the information you need. For many of the regulars, the trader's group is also a social event and they're found around the net frequency with their cronies sharing trading experiences and prices. Don't be reluctant to ask one about the value of a piece of equipment, since most hams are more than anxious to share their expertise.

"Listen around a bit and hear what's being offered at what price."

What's the downside?

Dealing at arm's length (not eyeball-to-eyeball) for an expensive item may be a nightmare waiting to happen. Net controllers are quick to remind participants that they are *not* responsible in any way for the transactions that take place on the net. As part of their disclaimer, they suggest that the involved parties attempt to resolve any dissatisfaction resulting from a sour deal. (You can see the importance of having a clear and written understanding of the transaction details should an item prove not to be to your expectations.) Generally, refunds are made by the seller with no questions asked.

For example, I recently purchased three Collins A4 mechanical filters for a newly-acquired receiver which was at that time away for extensive surgery courtesy of Howard W3HM. The deal was that the money would be refunded if the filters did not work. Four months later, the receiver was returned (with the front end sensitivity hotter than a firecracker); the filters were tested, and one didn't work. I sent a note to the seller in Pittsburgh and within a couple of days

received a refund. How's that for honesty and integrity and a tribute to the net participants?

Although problems are few and far between, situations do arise that require third-party intervention. In some instances, where the buyer and seller are at an impasse, the controller may intervene, determine the facts, and suggest a solution. On extremely rare occasions, there have been alleged instances of outright fraud and misrepresentation. If that's the case, take your postal money order receipt, canceled envelopes with all pertinent correspondence and visit the local postmaster. State your case, present the evidence, and learn whether the mails were used to defraud. Sometimes, a visit or call from the postal authorities can move mountains. If you've successfully identified an individual as a villain, get back to the net controller as quickly as possible with the details. That information will be put into the computer and a general announcement made to the net participants. In addition, the scoundrel may be denied further net privileges until the incident is resolved. It's a powerful and persuasive tool and I can assure you the word gets around, since most horsetraders have excellent memories and frequent many of the nets.

It never ceases to amaze me how few complaints are reported to the controllers as a result of a bad deal. This is certainly a tribute to the amateur radio fraternity and its generally high-principled individuals. This particular group loves to trade and they relish the art of the deal—they are careful to describe their wares accurately, and astute enough to price them realistically. If you're really fortunate, you'll locate the item you want from a ham across town. If you like what you see and it performs acceptably, pay the money and cart it home. Unfortunately, this is not the usual scenario, so, in the used gear arena the arm's-length deal remains a viable option. Prepare well in advance and have all of your "what-ifs" covered. Make up a memorandum of agreement, especially if it's a big ticket item. List as simply and succinctly as possible the description of the equipment and the terms of the deal. State clearly that money will be refunded if expectations are not met. Prepare two copies of the agreement and have a place for dates and signatures.

Still skeptical?

Thousands of deals have been consummated through the nets, so rest assured that the method works. Don't be overly apprehensive or hesitant to give it a try. You might even test out the system and gain some confidence by purchasing a low-priced item. When the package arrives, open the parcel immediately as the delivery driver stands by. Document the existence of any problems and file your claim without delay. If you're still a bit leery about dealing with someone a goodly distance away, check for horsetrader activity on the local VHF/UHF repeaters. If you can't locate an active group, suggest the idea to the club officers and perhaps consider being the net controller—most hams have a little horsetrader in them. I guess it's in the genes!

Acknowledgments: Special thanks to two gentlemen, net controllers Evan K9SQG (Sunday 7275 kHz 0930 EST) and Bill KJ8I (Monday 3898 kHz 1900 EST), who contributed net controllers' insight and perspective to this article. Dave WA3GIN, a dedicated horsetrader with a sense of humor, allowed me to include his E-mail comments on my note outlining some of the material being included in the article.

Dave wrote, "Yeah...make sure you talk about the folks who want new, in-the-box-with-the-manual, one-owner, non-smoker, guaranteed mint-condition, double-boxed, shipped UPS, but are willing to pay 1/10 the list price of the equipment, and of course the seller pays the shipping." 73

Net Operation Protocol

Log in by callsign *suffix* alphabetically at the net's outset. If time permits late check-ins are listed.

Prices of items being offered may be listed; however, any negotiations are by "twisted pair."

Prices need not be offered on the air at listing time.

A request for a specific item is OK.

Equipment must be in the lister's possession. *No third-party offerings!*

Condition should be honestly represented (scale 1-10) with any pertinent discrepancies noted.

Schedule of Traders' Nets (all times EST)

Monday	7:00 p.m. (0000Z)	3898 kHz	General equipment (packet related computers OK)
Tuesday	8:00 p.m.	146.880/280	General equipment (NYC area)
Wednesday	10:00 a.m.	7251 kHz	General equipment
	8:00 p.m.	3945 kHz	
	8:00 p.m.	3865 kHz	
Thursday	6:30 p.m.	3875 kHz	AM equipment (sideband check in OK)
Friday	8:30 p.m.	3870 kHz	General equipment (Texas)
Saturday	8:30 a.m.	3985 kHz	General equipment
	10:00 a.m.	7275 kHz	Old gear/amplifiers/components
	8:00 p.m.	3865 kHz	Drake and other older tube-type radios
Sunday	9:00 a.m.	7275 kHz	General equipment (two consecutive sessions run)
Note: At the completion of this Sunday session, there is often a computer net.			
	12:00 p.m.	14.317 kHz	Icom Net
	3:00 p.m.	14.363 kHz	Collins Net
	5:00 p.m.	14.275 kHz	Heath (not confirmed)
	5:00 p.m.	3942 kHz	General equipment
	8:30 p.m.	3922 kHz	General equipment

Build the Mag-Glass

Combine the best of the through-glass and the magnetic-mount antennas.

David K. Pelaez AH2AR/5
7309 Centenary Drive
Rowlett TX 75088

I had pondered, long and hard, on an antenna mounting system that utilized a through-glass type antenna—one that could be easily removed and remounted.

One type of commercially-made system I'd seen was a flat spring clip that connected the coupler and the through-glass antenna together, hinged like a clamshell. The problem with this system was that it required the through-glass antenna to be placed near the top of the window because the clip was designed to ride over the edge of the rolled-up window glass. Not only does this design limit your mounting options, it also brings the radiator very close to the gutter and roof.

Why not just use a "standard" magnet-mount antenna, and mount the antenna to the roof or trunk lid? This option also has its limitations. Magnets do not adhere to Fiberglas™ body panels, and magnet-mount antennas, even with rubber boots, will scratch the clearcoat or paint of the car if you aren't careful.

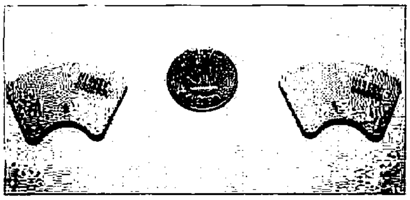


Photo A. The petal-shaped rare earth magnets, used after the creation of the original design.

New ideas

Someone once said that there is no such thing as a new idea; new ideas are just the synthesis and combination of old ideas. I knew there had to be some way to attach a through-glass antenna to an automobile window so that it wouldn't be necessary to pry the coupler and antenna off. Normally, through-glass antenna systems come with sticky pads on the coupler footprint and the antenna pad footprint. Once the pads are applied to the opposite sides of the glass, prying them off the window means replacement with new sticky pads. For temporary use, that's just not practical.

> ***"Once centered, these magnets had a grip like a gorilla!"***

Searching the junk box produced six neodymium iron-boron magnets I'd purchased several years earlier at Midwest Surplus, in Fairborn, Ohio. Rare earth magnets are used in high-efficiency generators and precision high-speed/high-torque electric motors.

Initially, I was amazed at their magnetic strength, and thought at the time that they might be useful for holding glued wood laminates together to support a woodworking project. They are, far and away, stronger than any conventional magnet available, and as I found these magnets were strong enough to stay in place on opposite sides of wood laminates up to three-quarters of an inch thick, I tested their strength on automobile glass and was equally impressed when I sandwiched the glass between two of these magnets. The magnets came together with a muffled snap, and I spent the next minute or so trying to remove them from the glass. Once centered, these magnets had a grip like a gorilla! My through-glass antenna problem had been solved.

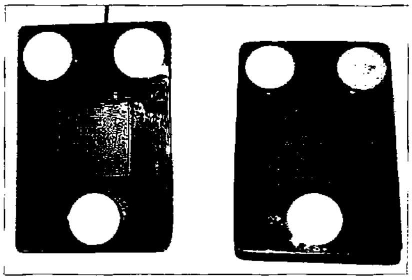


Photo B. The glass-contact side of the Mag-Glass baseplates.

Materials

The through-glass antennas used in this project are two-meter and 900-MHz antennas from Valor. Of course, any type of through-glass antennas should work. The Valor design has a fairly symmetrical base and I found their basic design makes cutting the Plexiglas™ I purchased at a hardware chain store relatively easy.

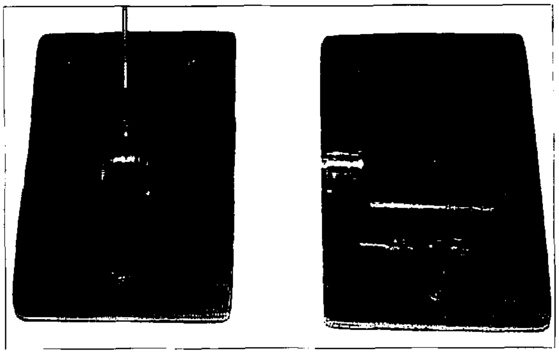


Photo C. Baseplates with epoxied antenna pad and coupler. The Plexiglas was painted black after construction.

Prototype #1 was made with 1/4-inch Plexiglas. The second prototype was made with a thinner 3/16-inch Plexiglas. Either of the two thicknesses will work, but my preference is the lighter 3/16 inch. I used a Dremel™ drill with a cutting bit to countersink the magnets into the Plexiglas. A barrel or cylindrical rotary file bit works well in routing out the Plexiglas (be sure to wear eye protection when routing out the holes). Slow-cure epoxy forms a bed for the magnets and holds the coupler and antenna base in place.

For this project, I used quarter-sized Neodymium iron-boron magnets (whose source has dried up), but equally strong and slightly larger Neodymium magnets are now available surplus through Marlin P. Jones and Associates (ordering information at end of article). Their magnets are not round—they are petal-shaped (**Photo A**).

You'll need twelve magnets for this project: three magnet pairs in each Plexiglas baseplate. The magnets are paired, then mounted and epoxied as single units into the Plexiglas. The dimensions and magnet placement shown are approximate, and not critical. The three magnets are placed in a triangular configuration; this placement seems to be the best orientation as it allows mounting on both flat and slightly curved glass surfaces.

Cutting

A coping saw, handsaw or scroll saw can be used to cut out the rectangular baseplates. Once you have cut out two baseplates, lay out the antenna coupler and the magnets in the configuration shown in **Photo B**. Using a sharp scribe or awl, scratch/trace the magnet and coupler outlines on the Plexiglas. If you are using the Valor through-glass antenna, pry off the rubber boot that hugs the circumference of the antenna pad. Once you remove this rubber boot, the antenna pad footprint will be slightly smaller than the coupler footprint (**Photo C**). This will not affect antenna performance. To hold the magnets in place for the tracings, you can use the other three magnets.

Be sure that both Plexiglas baseplates are configured so the magnets and coupler/antenna pad align when placed together. Once the tracings are done, remove the magnets and coupler, and countersink holes for the magnets and coupler.

"Please remember to slide the opposing baseplates away from each other—never try to just pull them apart."

Using a high-speed drill with a cutting bit, cut a pilot hole into the Plexiglas, about 3/32" deep (the depth of a single unpaired magnet). Use this hole as a depth guide for routing out the interior cavity for the magnet. Follow the tracing, and after completion, check to see how the magnet fits into the depression. Be careful if the fit is tight—it might be difficult to remove the magnet if you cut *too* accurately.

Now cut out a square hole for the coupler and the antenna pad; this can be done with a rotary file on the drill. Make a rough cut with a coping saw, and finish the sides of the cut with the drill. The coupler and antenna pad will be placed into the Plexiglas assembly so they will butt up against a glass surface, so they must be able to pass through the Plexiglas baseplate. A tight fit is desirable, but not essential. Before gluing the coupler and antenna pad, the magnets must be glued and pressed into their wells.

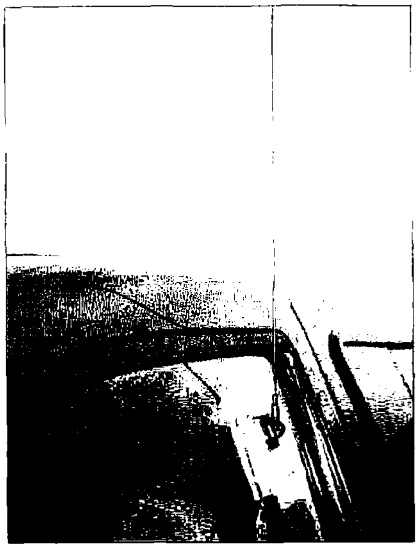


Photo D. Mounted prototype #1, stuck tight and working great.

Gluing

The magnets come from the supplier in a stack. I am not exaggerating when I say that it will take muscle to separate them into six pairs. You may find it easier to slide them apart by pushing them against a counter- or tabletop. Once you've got them separated make sure they stay that way by putting a buffer (scraps of Plexiglas, cardboard, etc.) between them. If they accidentally snap together, the force of impact can be enough to cause damage.

With a small drill bit, centered over the magnet depression, drill a small "weep hole" through the baseplate. When epoxy is loaded into the depression, this weep hole will allow some epoxy to escape when the magnet is bedded into the depression.

Check the magnets' mating to ensure that north-south polarity and magnet orientation are correct before gluing. Otherwise, the magnets will repel instead of attract when you try to put the baseplates together. Once the magnet pairs are glued and bedded into the Plexiglas, there will be a 3/32" space between the baseplate and the window surface. This 3/32" is the height of a single magnet that will be protruding from the well. The magnets will be riding on the surface of the window: as long as they are free of iron filings or other magnetically attracted debris, the smooth-coated magnets will not scratch the glass. Before you proceed with gluing the coupler and antenna

pad on their baseplates, be sure the paired magnets are glued and pressed into their respective wells.

The coupler and antenna pad

Once the bedded magnets and epoxy have dried/cured, it is time to glue the coupler and baseplate. Put the baseplate magnet-side-down on a smooth flat work surface. Push the coupler in from the top of the baseplate until it touches the work surface. Run an even bead of epoxy around the top edge of the coupler where it enters the baseplate. To keep the epoxy from oozing out between the coupler and the side of the cut-out baseplate before it sets, I found that coax sealant, available at electronics hobby stores, is a good temporary fix. Before gluing, keep the coupler aligned. Make a very small "rope" of coax sealant and put this material in any open gaps between the coupler and the baseplate to act as a removable dam.

The antenna pad is glued in the same manner, but I opted to fill the top of the antenna pad with epoxy as it sits a little differently from the larger coupler. The antenna pad, being physically thinner and smaller than its coupler mate, sits inside the Plexiglas baseplate in a well. I filled the well with epoxy, and also dammed the other side with coax sealant (once the epoxy cured, I removed the sealant).

Tips

Once the epoxy is completely cured it's time to try the antenna system out (**Photo D**). When placing the baseplates on the surface of the glass, put the opposing baseplates about six to eight inches away from each other on the glass and then slide them together. To remove your antenna from the vehicle, slide the baseplates apart; don't try to pull them apart. *Caution! Never put them on a metal surface*. If it is a painted surface, you will most assuredly scratch the paint. Do not place them on the hood or roof prior to installing them on the glass. The rare earth magnets are very strong—their attraction for metal surfaces is incredible, so be careful. When the antenna is mounted on the vehicle, follow the steps the manufacturer recommends for tuning. I have noticed that once the antenna is tuned (if the antenna is tunable—some through-glass antennas aren't), minor differences in glass thickness or antenna placement have little or no effect on VSWR.

What manufacturers don't tell you

Be aware that there are a number of newer automobiles with "passivated" glass. This glass tinting is created with a metallized spray process called "sputter coating," and is usually bronze- or silver-colored, but is available in a number of dark tints. This tinting process bonds a very thin layer of metal to the surface of the glass, and one of the unfortunate side effects of the coating/tinting is that it is RF opaque, which means radio frequency energy has a difficult time passing through it, and in some cases, can attenuate an RF signal by as much as 30 dB. Cell phone through-glass antennas, or any other through-glass ones will be attenuated when passing through this type of glass. Shifting to a different window, one that doesn't have the tinting, will solve the problem, but switching antenna locations would be a whole lot more difficult if you had used a permanent-mount through-glass antenna.

Storage

When storing this antenna after use, make sure you don't put the two baseplates together without a buffer of some kind—you can damage the Plexiglas or even pull a magnet out of its bed with the strong magnetic force. It is also not a very good idea to store this system near your priceless 3-1/2 inch floppies, or set it on top of your computer's hard drive.

If you want to keep the cost of this project down, one approach is to use six magnets instead of six pairs. I feel that the extra strength provided by the pairs pays off in security, though. They'll hold tight through the thickest automotive glass.

In researching the cost of new rare earth magnets, I found that they would cost about $40 *each* if bought singly from a company in Dallas. Surplus Neodymium iron-boron magnets are available by catalog from Marlin P. Jones and Associates. The part number is 7454-MG, and they are priced at $1.40 each. Call toll-free (800) 432-9937.

Maximize Your Transceiver's Tuning Range!

Computer control for the Ramsey transceiver kit.

Richard E. Lucka WD8BNR
162 Olde Mound Lane
Pickerington OH 43147-1180
[rlucka@aol.com]

The Ramsey digital transceiver kit series includes rigs for 6 meters, 2 meters, 220 MHz, and 440 MHz. Each is capable of programming 12 frequencies, or channels, using diodes. The rigs have good receiver sensitivity with plenty of audio output and transmit at about 5 watts. The rigs are perfect for mobile and packet applications.

You can maximize the frequency capabilities of your Ramsey rig and use IBM-PC software to (to name a few):

• tune all available channels within the ham bands (and transmit, too)

• scan and listen to many more frequencies outside the ham bands

• listen to both repeater outputs and inputs with a touch of a function key

• adjust the scanning rate and signal drop wait rate

• scan up or down frequencies using increments you select

• scan frequencies using a frequency list you can build

• divide your frequency list into categories (i.e., ham repeaters, police, fire, business, paging, hospitals, MARS, etc., etc.)

• survey within a frequency range to create a file of active frequencies

• create a packet control program to monitor a frequency and at times transmit a beacon on other frequencies letting the world know what frequency you are monitoring

• temporarily lock out frequencies while scanning (some digital pagers are annoying!)

... and on and on and on—all limited by your imagination and programming skills (if you "roll your own").

Intrigued? Then read on to see how you can build the IBM-PC computer interface that connects between your transceiver and PC parallel port.

Fig. 1 shows the interface circuit built on a Radio Shack™ 276-150 prototype board mounted on top of the transceiver's adder chips (U7 through U10). **Fig. 1** also shows a computer cable running through the modified transceiver power inlet and the necessary connections between the interface and the rig's main board. The other end of the computer cable connects to your PC's parallel port. **Fig. 2** shows additional mounting details using leftover cable insulation as legs and one corner resting on top of crystal Y2, held in place by twisted insulated telephone wire to the RECV bus wire.

The schematic (**Fig. 3**) shows the connection between the PC parallel port and the interface and another connection between the interface and the transceiver. **Table 1** shows the structure of the parallel ports from a programmer's viewpoint.

Central to the interface circuit are U1 and U2, the MC4094 or MC14094. Each chip is an eight-stage shift/store register with three state outputs. A 4094 chip has four inputs and 10 data outputs. See **Fig. 4** for the chips' pin layout. Outputs Q1 through Q8 are

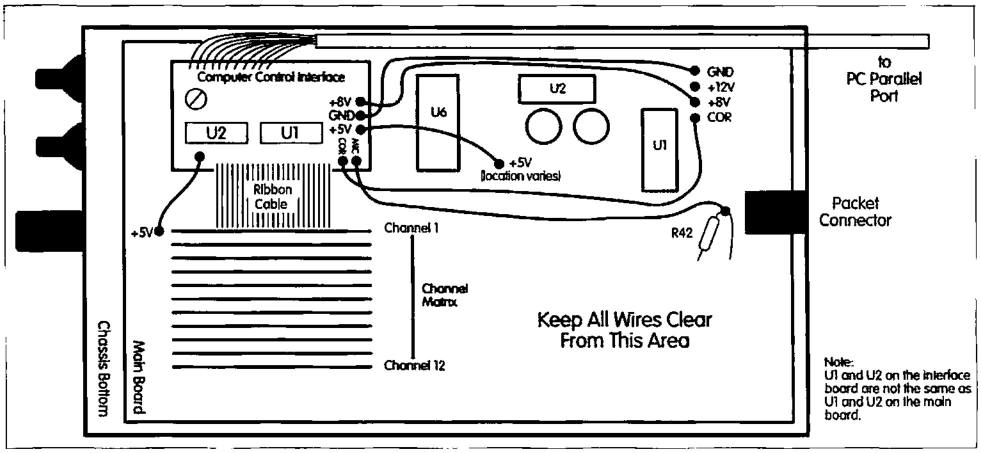


Fig. 1. The Computer Control Interface mounted above the Ramsey transceiver's address chips.

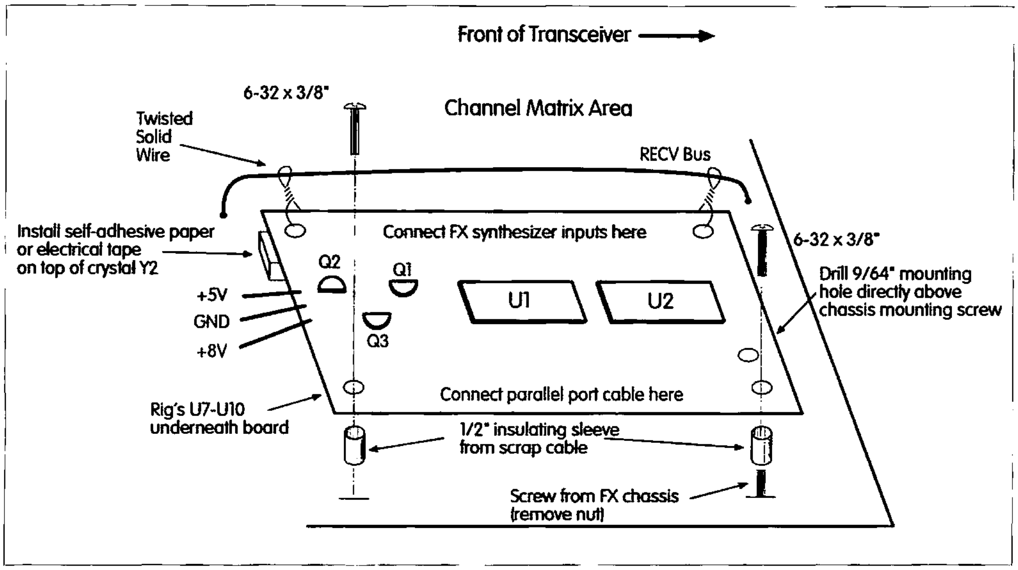


Fig. 2. Mounting details, view from the left side.

latches while Qs and Q's are serial outputs used for connecting several 4094s in tandem. The inputs are: data, strobe, clock, and output enable (OE).

A "latch" stores a voltage (low or high) and makes it available to the outside world from the chip. In our case here, the data is available for input to the rig's synthesizer chip. The term "low" means low voltage, or logic 0.

A "high" means high voltage (about 5 volts), or a logic 1. The term "rising edge" means a voltage transitioning from a low to a high (0 to 5 volts) and "falling edge" means the opposite.

When the clock input swings from a logic low to a logic high, data is shifted inside the chip's buffers. In other words, the data in the buffer for Q7 is moved to the buffer for Q8, then the data in Q6 is moved to Q7, and so on until Q1 is moved to Q2. The data that appears on the input data pin is moved to Q1. As long as the strobe input is low, the shifted data will not transfer to the output latch.

When the strobe input swings from high to low, the newly shifted data is latched to the output pins Q1 through Q8. Thus, after shifting new data, you only need to swing the strobe input from low to high and then back from high to low. If the strobe was already high and stayed there, when you shift data the outputs will reflect the data flow. For the sake of our circuit, we don't want to change the synthesizer inputs in a seemingly random fashion as we shift in the data of a new frequency, especially during scanning, so we must keep the strobe input low.

The output enable (OE) input determines the output state of Q1 through Q8. If OE is high, then the outputs contain logic lows and highs, depending on how you program the chip. However, if OE is low, then the outputs are "floating," or in a high impedance state. This is useful when you want to use the frequency selector switch on the transceiver and not let the chips interfere with other frequencies you select in the rig's channel matrix.

So, if you want to shift an eight-bit number into the chip's outputs (Q1 through Q8), do the following:

1. Keep the strobe input low and the output enable (OE) high.
2. Send a data bit into the data input.
3. Send a high to the clock input. The rising edge of the clock input causes the chip to shift all the data bits in the chip to shift one bit. The new data on the data input bit goes into D1 while the data in D7 goes into both Q8 and Qs. Having done this, send a low to the clock input. The negative edge of this transition causes the data on Qs to show up on Q's. Note that none of the bit transitions will actually appear on the D1 through D8 output latches as long as the strobe input is low.
4. Repeat steps 2 and 3 until all eight bits from a byte have been shifted into the chip.
5. Now, send a high and then a low to the strobe input. The falling edge of the strobe input copies the new data in the chip's buffers to the output latches Q1 through Q8. The new data will stay on the latch outputs no matter what is going on in the inputs, as long as the strobe remains low and OE remains high.

How the interface works in your Ramsey radio

The output enable (OE) input lends itself well to this project. It is hard-wired to the +5 connector from channel 1. If channel 1 is not selected (OE is low), outputs Q1 through Q8 will "float" and assume whatever state (high or low) as a function of another circuit.

The "other circuit" in our case is whatever frequency you select using the transceiver's frequency selector knob. Thus, when you select channels 2 through 12, you take away the +5 volts from OE and resistor R5 pulls the voltage down and causes the OE input to go low and the outputs to float. When you select channel 1, OE goes high and you will return to the frequency already stored in the interface and return to "computer control" mode.

OE shows up in bit 4 of the input port so your software can detect whether the interface is selected or not.

The interface has U1 and U2 in parallel with each other, not one in tandem behind the other. This allows only eight-bit shifts for both chips, rather than 16-bit shifts, which take longer to do. As you can see in the schematic, the interface does not use the Qs and Q's outputs.

U1 programs the upper eight-bit inputs (32k through 256) to the MC145152 synthesizer (the rig's U6 chip) while U2 programs the lower eight-bit inputs (128 through 1). Please note that the interface's U1 and U2 should not be confused with the transceiver's U1 and U2.

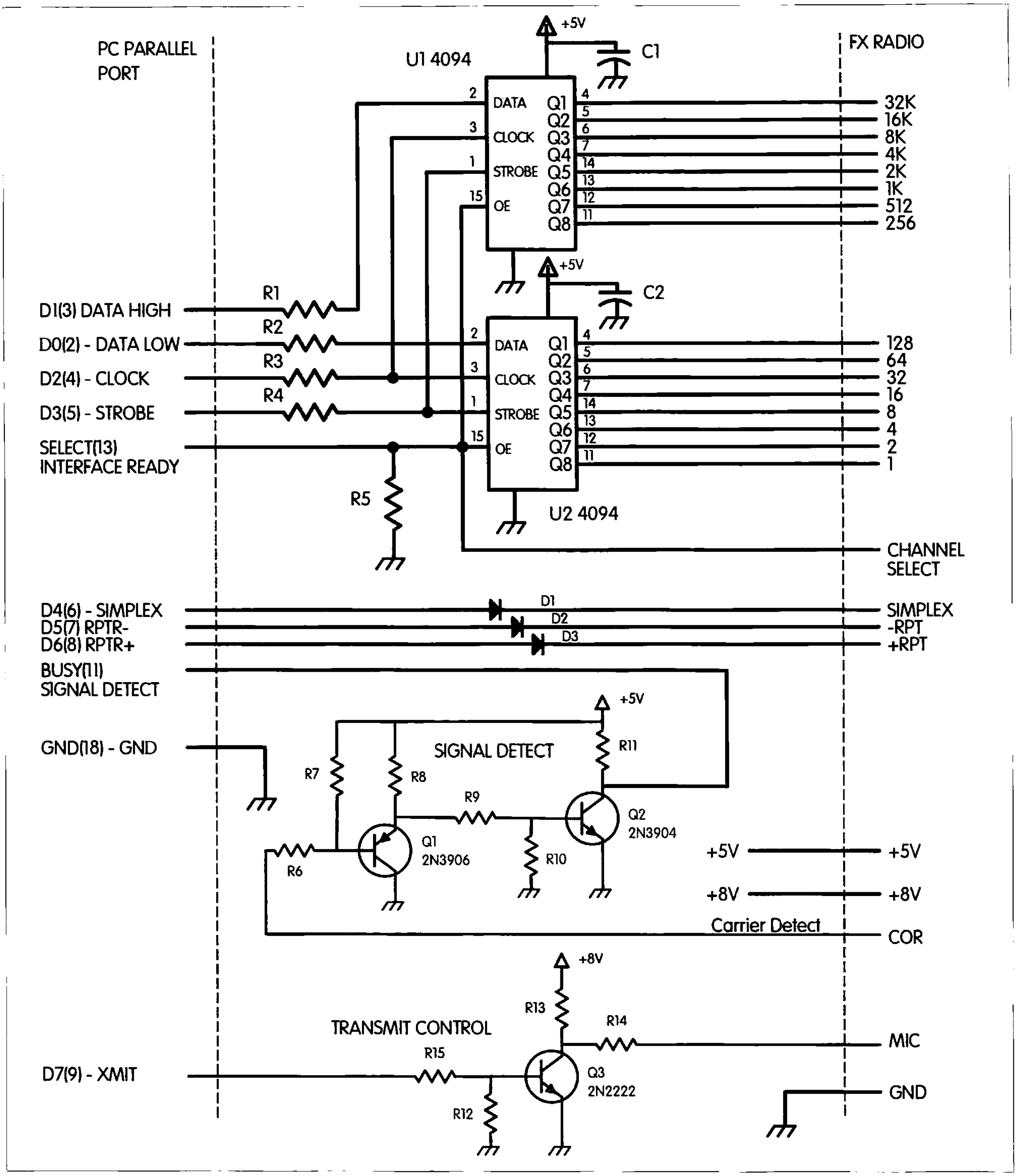


Fig. 3. Ramsey FX radio/PC interface.

The schematic shows the lower four bits of the PC's output parallel port being used for programming the inputs to the synthesizer. Bit D0 is connected to the data input of U2 while bit D1 is connected to the data input of U1. Your program will have to split the upper and lower halves of the synthesizer programming word (which is fully described in your Ramsey manual) and shift the bits (lowest bits first, or right shift) into the chips. Bit D2 controls the clock input and bit D3 controls the strobe input to both chips.

Bits D4 through D6 control the transmit offset selection on the transceiver. The programming of these bits must be consistent, and only one bit (D4, D5, or D6) can be high at a time. The Ramsey manual thoroughly explains how the transmit offsets work through the rig's adder chips (U6 through U10).

R1 through R4 limits current flow between the chip inputs and the PC

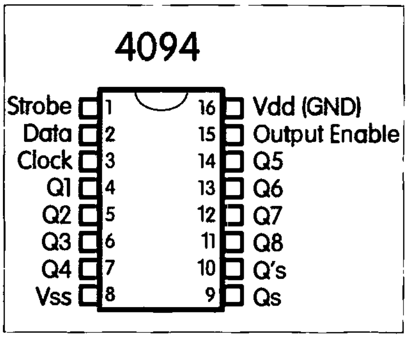


Fig. 4. Pin layout.

parallel ports whenever the PC is on and the radio (and interface) is off.

D1 through D3 protect the transceiver's 5-volt regulator when you have the transceiver on and the PC off.

Without these diodes, there may be a virtual short circuit condition when the PC is off which may cause the transceiver's 5-volt regulator to overheat and enter thermal shutdown.

The signal detect circuit allows your program to detect the presence of a signal. You can use this circuit to stop a scanning function if you sense a signal, and then resume scanning when the signal drops. The signal detect gets its signal from the COR output of the FX-146's product detector (U1). Since the COR is analog in nature, Q1 and Q2 convert the analog to digital and return a high for no signal and a low for a signal.

The COR output from your rig is part of the rig's squelch circuit. If you turn down the squelch until you hear background noise, the COR voltage will change and your PC will sense a "signal." In order for the signal detect circuit to work properly, adjust the squelch so that the background noise just drops off and leave it there.

The transmit control circuit uses the D7 output bit from the parallel port to control the transmit function.

This bit must always be low (for receive mode) when programming the frequency of the transceiver. Make sure you don't inadvertently set the transceiver in transmit mode by throwing random data on the output. In this circuit, R13 serves a dual function. First, it limits the collector current when you send a logic high to saturate Q3 and therefore lower the voltage going into the MIC input, which causes the transceiver to go into transmit mode.

Second, it keeps the MIC input high (keeps the rig in receive mode) if your PC happens to be off or in reset mode (booting up, when the output of the parallel port is in a high-impedance state). Connect the transmit control "MIC input" to the top of the rig's R42 (scrape away any insulating material first before connecting and soldering).

If, after assembling the interface circuit, the XMIT does not make your transceiver go into transmit mode, try reducing R14 to 68k or 47k. I had to do this for my FX-440 rig (100k was OK for the other three rigs).

Use the 5- and 8-volt supply directly from the transceiver. Both power supplies have ample reserves to power this interface.

Structure ot the parallel port data register:		
Port address: First parallel port (LPT1) = 378H Second parallel port (LPT2) = 278H		
	Function	Male DSUB
D0	Data low	Pin 2
D1	Data high	Pin 3
D2	Clock	Pin 4
D3	Strobe	Pin 5
D4	Simplex	Pin 6
D5	-RPT offset	Pin 7
D6	+RPT offset	Pin 8
D7	XMIT	Pin 9
Structure of the parallel port status register:		
Port address: First parallel port (LPT1) = 379H Second parallel port (LPT2) = 279H		
	Function	Male DSUB
D4	Select (1 = rig is on)	Pin 13
D7	Busy (0 = signal detect)	Pin 11
	Signal Ground	Pin 18

Table 1. Structure of the parallel ports.

A BASIC program showing how to program your radio can be downloaded from my FTP site. The ex-ample program requires Microsoft QBasic (available in DOS version 5 and above) or Microsoft QuickBasic version 4.5.

Additional programs are available from my FTP site. One is a deluxe, full-featured interactive scanner program, which you can run directly from the DOS command line.

How to find frequency limits

As with all radios, there are frequency limits. Ramsey doesn't tell you what the limits are, mainly because the limits can be changed somewhat.

They did tell you that your transceiver can be tuned to any 20 MHz segment, or 5 MHz segment for the FX-50. The transmitter range is much narrower, and it is just as well, so keep them tuned within the ham bands.

The transceiver's MC145152 frequency synthesizer has a Lock Detect output pin which, after being filtered, connects to the rig's U5, pin 5. You can connect a high impedance digital voltmeter to this pin.

When you tune to a frequency and it is within range, pin 5 will show about 5 volts, or at least more than 4 volts. If the voltage is lower than 3 volts, then you are out of range.

Remember, when building your kit, you had to tune your radio by adjusting coil L7 until you achieved a certain voltage at TP1 for a particular frequency? There is nothing sacred about the voltage value—it was Ramsey's way of ensuring that your radio would be tuned within a certain desirable frequency range, which would cover the entire ham band the rig was designed for.

You can tune L7 to move the frequency limits up or down. If you move the lower limit, you also move the upper limit. Just keep in mind that there is only so far you can go because of the limits of the coil and the overall circuitry (see **Table 2**).

Radio	Low Frequency	High Frequency
FX-50	48.650	54.550
FX-146	137.370	171.100
FX-223	204.270	265.900
FX-440	400.150	471.000

Table 2. Receiver frequency range for various radio models.

As you can see, the UHF radios have a higher frequency range than do the VHF radios. However, the transmitter still has a narrow range (by default, that helps to keep your transmissions within legal limits).

Availability

You can get all the software I have for programming your rig(s) using the circuit described in this article. The programs run in DOS mode. You'll find several programs in my FTP site; if you prefer, you can write your own software and use the frequency programming routines as a guide or an addition to your programs.

Send a blank diskette (5-1/4 or 3-1/2) plus five dollars (to cover S&H) and I will return it to you loaded with all the software I have. If you can access the Internet, check out my humble FTP site at [ftp://members.aol.com/rlucka/fxradio].

Please note one important point: Even though the Ramsey transceivers are capable of transmissions outside the ham bands, you must have an appropriate license to transmit outside the ham bands, just as you must be licensed to transmit within the ham bands. In addition, even if you are licensed to operate in a business segment that the Ramsey can tune to, the Ramsey is not type-accepted for use in these bands. Any excursions outside the ham bands must be "receive-only."

The FCC expects you to maintain strict control over your new capabilities and will enforce strict penalties for unlicensed transmissions, whether malicious or accidental.

If you have any ideas, suggestions, questions, whatever, feel free to contact me with an SASE or E-mail me at [rlucka@aol.com]. I plan to add to or improve the software and leave the latest versions in my FTP site, so check in once in a while to see what's improved or new. Some of the additions and improvements may be from your ideas, so communicate!

The transceivers are available in kit form from:

Ramsey Electronics, Inc.
793 Canning Pkwy
Victor NY 14564
(716) 924-4560

FX-Series Interface Parts List	
C1, C2	0.1 µF
D1, D2, D3	1N4148
Q1	2N3906
Q2	2N3904
Q3	2N2222
R1, R2, R3, R4	1k
R5, R6, R9, R11, R12, R13	10k
R7, R14	100k
R8	4.7k
R10	3k
R15	47k
U1, U2	MC4094 or MC14094
Circuit Board	RS 276-150
12-wire cable for connection to PC parallel port	
Ribbon cable (optional)	
Male DSUB connector for PC parallel port	
Chip socket for U1, U2 (optional 16-pin sockets)	
Small-gauge wire for point-to-point connection (solid preferred)	
Mounting hardware (see text): machine screws, cable insulators, insulating paper, bell wire	

TV/VCR Tuner Applications (Part 3)

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

Spectrum analyzer

Perhaps one of the handiest tools for electronics is the spectrum analyzer. In essence, it is a receiver having an oscilloscope attached which is used to provide a spectral view of a band of selected frequencies. The amount of spectrum to be viewed can be varied for either a close-up view of the signal, or a greater amount for viewing all of the adjacent signals within the band. The usefulness of the spectrum analyzer is great, with many applications. To name a few: transmitter sideband analysis, spur generation analysis, frequency spotting and identification, identifying modulation mode, harmonic signal analysis, and use as a wide frequency range receiver.

The spectrum analyzer described here is constructed using relatively easy to obtain components so that it is a project within reach of any ham experimenter. The two main components are the TV/VCR tuner and a receiver. Although a receiver board may be constructed, almost any receiver capable of tuning to the tuner's IF (46–63 MHz) and having an AM detector will create a fine spectrum analyzer. I assume that you prefer to use a pre-built or commercial receiver, so a simple home-brew receiver will not be discussed. Many suitable receivers are available that will tune the 46–63 MHz region, such as six-meter AM and 30–50 MHz WWII military receivers. Even a 27-MHz CB AM radio used in conjunction with a 47- to 27-MHz converter will work well. The narrow IF bandwidth of the receiver provides narrow dispersion for viewing signal carrier and sideband characteristics.

The block diagram in Fig. 1 shows the major components and interconnects for a spectrum analyzer. When in operation, a sawtooth voltage is applied to the tuning voltage line, causing the tuner to sweep across a band of frequencies. Any received signal within that band will be translated to a DC voltage whose amplitude is relative to the strength of the signal which is then displayed on the vertical plane of the oscilloscope. In order to maintain a steady display on the screen, the horizontal scope sweep must be synchronized with the sawtooth generator. The sweep speed is set just high enough to eliminate viewing flicker. A high sweep speed does nothing to improve the display. Any basic oscilloscope may be used, but perhaps the main requirement for the scope is to have a DC input so that it will respond to the rectified output signal from the receiver's AM detector.

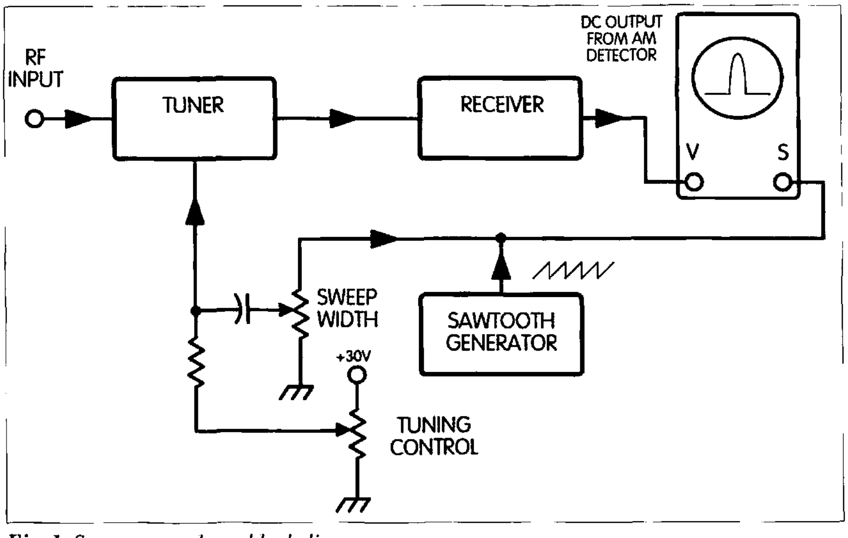


Fig. 1. Spectrum analyzer block diagram.

Fig. 2 shows the complete schematic for the spectrum analyzer with the exception of the receiver details. To drive the tuner sweep circuit, a unijunction transistor was chosen to generate the sawtooth waveform, but any sawtooth generator circuit will work in this application. In order to provide a fairly linear sawtooth ramp, a JFET is used as a constant current source for charging the timing capacitor. A voltage pulse is taken from the B2 terminal of the UJT to provide a sync pulse for the scope.

As an alternative sweep source, some oscilloscopes provide a horizontal sweep sawtooth output which may be divided down with resistors and applied to the sweep width pot. The sweep voltage amplitude as generated within the scope may be as high as 100 volts, but the maximum desired sweep voltage is about 10 volts when applied to the sweep width pot. On the average only 0.5 to 1 volt is required to provide a normal spectral display (sweep width).

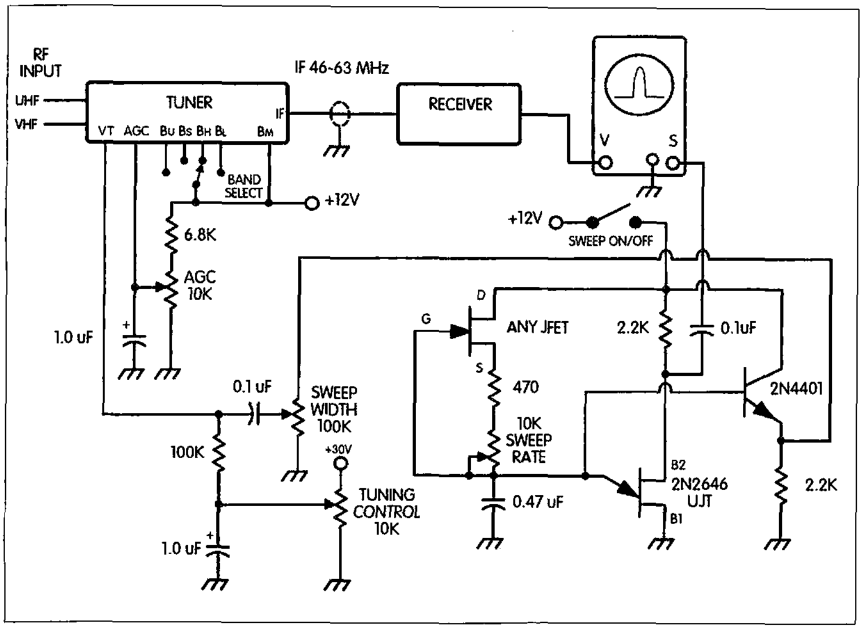


Fig. 2. Spectrum analyzer schematic.

Power supply regulation, although not as critical for the +12 volt line, is recommended to reduce tuner drift. Regulation is very critical for the tuning voltage circuit, however, and care must be taken to remove all ripple and noise. The tuning is performed by using a 10k pot across the +30 volt source. For vernier tuning control, a 10-turn pot and a counter knob are recommended.

Almost any small 24–28 volt, 100-200 mA, power transformer is suitable for use in the spectrum analyzer. It is suggested that filter capacitors have a value equal to or greater than 3300 µF to keep power supply ripple and noise to a minimum.

Mechanically, the circuit is very stable and can be mounted in any convenient manner to suit your taste.

Signal source

TV/VCR tuners were designed to be the front end of a receiver. As such, they contain a local oscillator which is used to mix with the incoming signal to create an IF of approximately 47 MHz. The tuner, as a receiver front end, covers a received frequency range of 45 to 900 MHz. The oscillator operates above the received frequency and is offset by the IF (46-63 MHz). Therefore, the oscillator operates over the range of approximately 90 to 950 MHz. The actual oscillator range is dependent upon the specific tuner. Typically, TV oscillators tune from 91 to 940 MHz while VCR oscillators tune from 108 to 955 MHz.

Some tuners are set up with a phono connector near the oscillator circuit that outputs the oscillator signal to the PLL frequency control circuit. In most cases, the output is frequency-divided prior to exiting the tuner case, making the output generally unusable. However, some tuners provide a direct oscillator output, and when that is the case, the tuner will work as a signal generator without modification. When

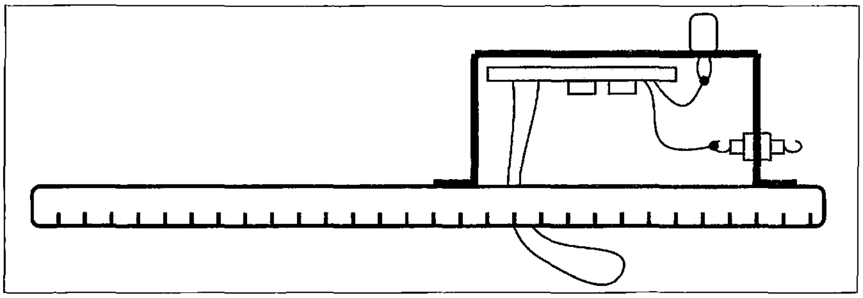


Fig. 3. Amplifier mounting and coupling. The pickup loop feeds signal from the oscillator to the amplifier board.

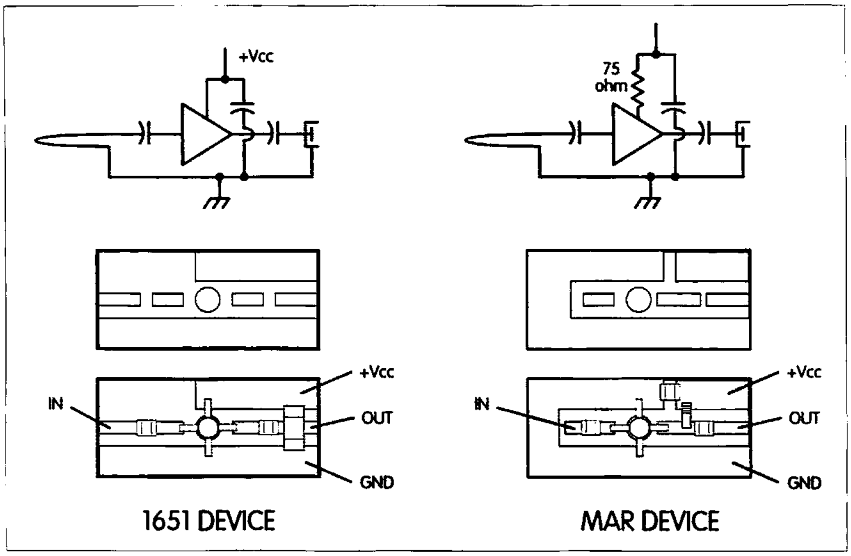


Fig. 4. Schematic, PC board layout, and parts placement for the amplifier board, shown for the two devices discussed in the article.

access to the oscillator is not available, the tuner may be modified slightly to obtain a direct signal from the oscillator. There are many techniques available to capture the oscillator signal, but only one technique will be described here.

The concept for capturing the oscillator signal is shown in Fig. 3 and involves drilling a hole in the tuner cover to provide access for a wire pickup loop to pass through the hole, allowing the loop to lie close to the oscillator circuit. The loop picks up a signal which is fed into a broadband amplifier. A coupling capacitor is connected between the loop and the amplifier to satisfy the isolated DC input requirement of the amplifier. The amplifier provides a constant load on the oscillator and is used to amplify the signal captured by the loop. If the tuner cavity is large enough, the amplifier may be mounted inside of the tuner rather than on the cover. Otherwise, the amplifier must be mounted outside of the tuner. To prevent radiation from the amplifier, the circuit must be enclosed in a metal box made from a tin can. The box is made RF-tight and soldered to the tuner cover. The box may be of any convenient dimensions, but it must be RF-tight.

Power for the amplifier is in the range of 4.5 to 5 volts. To prevent chip heating, the voltage at the chip should not exceed 5.5 volts. The power to the amplifier must be fed via a high capacity feedthrough.

A phono connector may be mounted on the amplifier box and used as an RF output connector. The amplifier output impedance is 50 ohms. To provide proper amplifier operation, the chip is mounted on a small piece of printed circuit board which is glued to the inside of the box.

The amplifier chip used in the original design of the circuit was an NEC UPC1651G. As an alternate part, a Mini-Circuits MAR-1 or MAR-2 may be used. A 75 ohm 1/4 watt resistor is used with the MAR series chip to source Vcc to the chip. An output impedance of approximately 40 ohms is achieved, which will source a 50 ohm line satisfactorily. The respective chip circuits are shown in **Fig. 4**. Capacitor values used in the circuit are not critical, as any value from about 0.001 to 0.5 uF will work. It is important to keep the physical size of the capacitor small and lead lengths kept very short. Chip capacitors are preferred when available.

After making the tuner into a signal generator, it will still function as a normal signal converter/tuner. The addition of a pickup loop will shift the oscillator frequency a small amount, but not enough to prevent the tuner from functioning as designed.

Multifunction signal device

If you haven't noticed, all of the new pieces of ham equipment abound with a multitude of functions and capability. As a result, some marvelous equipment and innovations are offered to the ham community. Equipment designed and built by hams may also exhibit multiple innovations when a little thought is applied.

Parts/components for ham-designed equipment come from some surprising sources and places. Therefore, it should come as no surprise to find TV/VCR tuners designed into a multifunction device having the following functions: frequency converter, spectrum analyzer, signal generator, sweep generator, and standard deviation signal source. All of the indicated capability is achieved with external circuits and with a minor modification to the tuner to extract a signal from the local oscillator.

Before we conclude, let me remind you that the actual frequency band obtained from a tuner is determined by the individual manufacturer's design. Therefore, all frequencies indicated

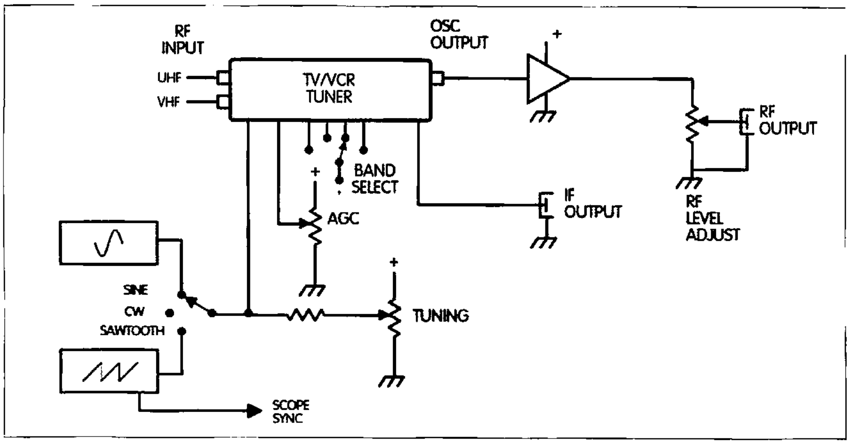


Fig. 5. Multifunction signal device block diagram.

here can only be used for reference. Refer to the previous articles in this series for more information.

Tuners typically require two source voltages for proper operation. Positive 12 volts is applied to the mixer/oscillator and band control circuits, and is divided with a pot for the AGC. The AGC may be used as the RF gain control. A variable voltage from 0 to 30 volts is used for tuning. Both of the voltage sources should be regulated to achieve best tuner stability. It is also recommended that large value filter capacitors be used to keep power supply ripple and noise to a minimum.

For a TV/VCR tuner to be useful as a signal generator, a signal output must be obtained from the local oscillator. Some tuners have a phono connector mounted next to the oscillator circuit which was used to output a signal to the PLL. Some tuners have the oscillator output divided before it exits the tuner which reduces the tuner's desirability. However, modifying the tuner will allow obtaining a direct signal from the oscillator.

"A wealth of testing for very little cost..."

Fig. 5 shows a block diagram of the multifunction signal device with a tuner as the major component. Output from the oscillator is sampled and amplified using a monolithic RF amplifier chip. A pot in the amplifier's output circuit is used to control the signal output amplitude. As a signal generator, three modulation functions are provided. Obviously, when in the CW mode there is no modulation present, but modulation is present when either a sine wave or sawtooth waveform is used. FM is the resulting modulation mode when either waveform is applied.

Fig. 6 shows the schematic for the multifunction signal device. To build the device, it is recommended that the supporting articles be reviewed to gain additional technical information.

Following is a brief description of each function of the device:

Frequency converter. The TV/VCR tuner was designed to be the front end of a receiver so no tuner modification is required to use it for that purpose.

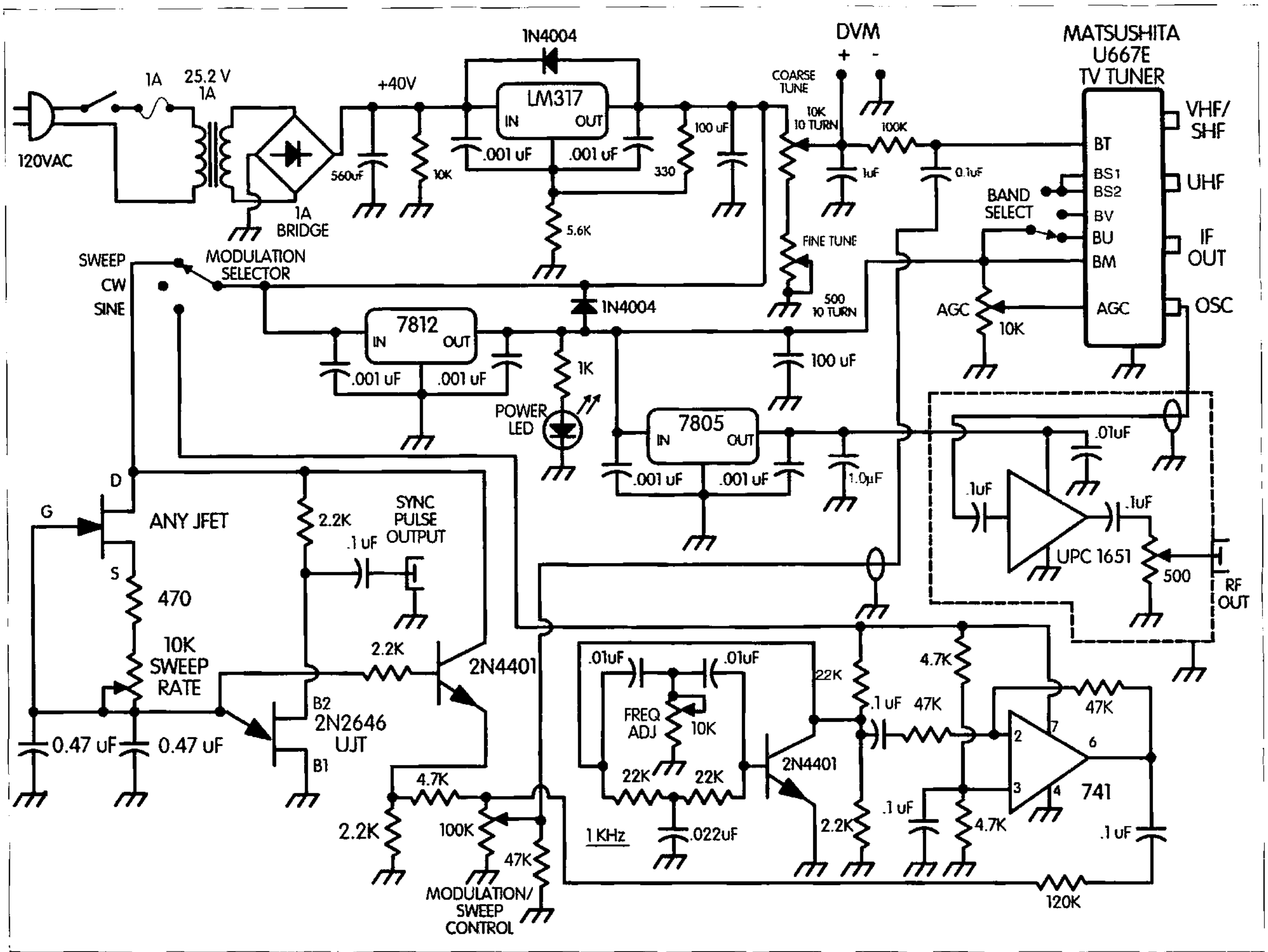


Fig. 6. Multifunction signal device schematic.

Any receiver capable of tuning to the tuner's IF will work well. To name a few: 6-meter receivers, scanners, WWII 50-MHz receivers, and a CB radio used with a 47–27 MHz frequency converter. As a downside, it must be mentioned that tuner drift may be noticed when a narrow passband receiver is used with the tuner. Using the tuner outside of a PLL, the local oscillator frequency stability is subject to voltage and thermal variations.

Spectrum analyzer. The multifunction signal device becomes a spectrum analyzer when used as a frequency converter. An AM receiver with a DC output voltage obtained from the detector is used to provide a signal to the DC input of an oscilloscope. A voltage pulse from the sweep generator is used to synchronize the scope sweep with the tuner's spectrum sweep.

Sweep signal generator. When a sawtooth signal is applied to the generator, the frequency of the generator will sweep across a band of frequencies and then snap back to the starting frequency. The frequency sweeping process is repetitive and the sweep range is controlled by the amplitude of the sweep voltage.

There are two major objectives when using a sweep generator. The first is to profile the frequency response of a resonant circuit, RF or IF amplifier, or any other narrow passband circuit. The second objective is to provide the necessary sweep voltage for sweeping the tuner over a band of frequencies when the tuner is used as the front end of a spectrum analyzer.

Standard deviated signal source. The objective of modulating the signal generator with a sine wave has two advantages. The first is to provide audio modulation for identifying the output signal when the device is used as a signal generator. The second objective is to generate a signal having a specific value of deviation. In the process of deviating a signal, sideband energy is created as a function of the frequency of modulation and the rate of deviation. As the amount of deviation is increased from zero, the carrier will pass through a series of null points which are used as a measure of deviation.

A 1-kHz sine wave provides a predictable carrier null vs. deviation at 2.405 kHz at the first null and 5.520 kHz at the second. The carrier null can be observed using a receiver having a BFO centered on the generator's carrier, which will null at a specific deviation as the amplitude of the modulation is increased from zero to that point.

It should be noted that the multifunction signal device can be built and tested a section at a time, or you can build just as much as you need. Whether you build just the spectrum analyzer or the complete multifunction unit, the use of a surplus TV tuner provides a wealth of test capability for very little cost.

The NiCd Health Maintenance System

Build this project to get maximum life out of your expensive NiCd batteries.

Sam Ulbing N4UAU
5200 NW 43rd St.
Suite 102-177
Gainesville FL 32606
[n4uau@afn.org]

Radio control projects, hand-held radios and GPS receivers are just a few of the many places we use expensive NiCd batteries. To get maximum life out of these batteries it is necessary to properly maintain them. Overcharging and overdischarging them can shorten their life significantly. Short-cycling them a lot will also reduce their capacity because the metal crystals in the battery will coalesce if left undisturbed for a long time, increasing the internal resistance and lowering the terminal voltage. Repeatedly charging the batteries after only partial discharge will leave the lowest layers of the metal undisturbed, allowing them to coalesce. This effect can be eliminated by completely discharging the cell occasionally before it is charged. The NiCd Health Maintenance System consists of three easy-to-build projects that will help you to get the most out of these expensive batteries.

• The NiCd Health and Fitness Center (**Photo A**) will let you pre-condition and recharge your battery packs correctly. It will prevent overcharging and reduce "memory" effects due to short cycling.

• The NiCd Personal Fitness Advisor will help you identify weak or aging cells within a battery pack, so you can match like cells for maximum life or discard worn-out cells.

• The NiCd Tiny Fitness Tester (**Photo B**) is a portable, self-powered, very small unit that will let you accurately measure your battery voltage when you are away from your Fitness Center. It is much smaller than a standard digital voltmeter, so it's easy to take it with you when you travel.

This project was inspired by an "Idea for Design" by John Wettroth in *Electronic Design Magazine*, January 22, 1996. I felt I could improve the design with some modifications and additions. Though the project I describe is designed for use with four cells, it is possible to modify it for a different number of cells.

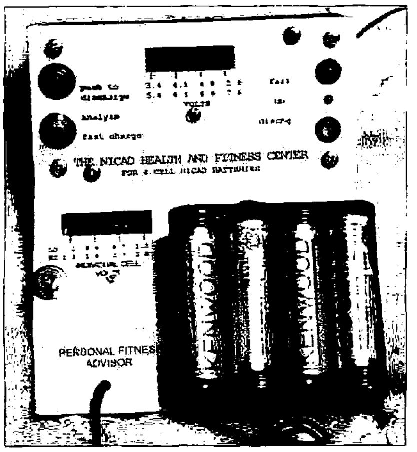


***Photo A.** The NiCd Health & Fitness Center with the Personal Fitness Advisor.*

The NiCd Health & Fitness Center (H&FC)

The H&FC will keep your batteries in good shape by exercising them properly. Put your batteries in it at night and by morning you will have healthy reconditioned batteries ready to go. It consists of:

• An auto discharge circuit that will discharge your batteries to the proper voltage to reduce crystal coalescence, and then automatically initiate the recharge process.

• A MAX713 fast charger chip (U2), which charges the batteries quickly without overcharging them.

• An LM3914 voltmeter (U1), which accurately displays your batteries' voltage so you can decide when to charge or discharge.

Using the H&FC

Insert your batteries, set switch (SW1) to "analyze" and turn on the power. The built-in voltmeter will show the battery voltage from 3.4 volts (.85 per cell) to 5.60 volts (1.4 per cell) in 10 steps. You can remove and use them, or you can decide to recondition them by either just charging them or discharging and then automatically recharging them.

To charge your batteries move SW1 to "Fast Charge" and the charging IC will begin to charge the batteries at 250 mA, which is about one third of the capacity of AA NiCds (called a C/3 charge rate). When the charge cycle is done (three to four hours) the H&FC will switch to a trickle charge mode (C/16). Notice that this trickle rate is much less than the C/10 rate commonly used by "slow" chargers, greatly reducing chances of overcharging if the batteries are left connected to the charger for a long period of time. The H&FC displays the battery voltage during charging to give you a feel for progress.

***Photo B.** The Tiny Fitness Tester, compared to a standard DMM.*

You can also choose to discharge your batteries to recondition them (the complete workout). Push the discharge button and the circuit connects the built-in discharge load. Again the voltmeter monitors and displays the battery voltage. When discharge is complete (voltage is less than .85 volts per cell), the discharge cycle is terminated and the charge cycle begins automatically.

Circuit description

See **Fig. 1**. U1 is a 10-step voltmeter based on an LM3914. If the battery being measured at pin 5 has a voltage less than the minimum level set, no LEDs will be on. As the voltage increases, LEDs will start to turn on one at a time, from left to right, until the voltage reaches or exceeds the maximum level set. Which LED is on gives an accurate indication of battery voltage.

The maximum and minimum levels of this voltmeter are set by R1, R2, and R3. A current (I) from pin 7 of U1 which is set by R3 flows through R1 and R2 to ground. The voltage across R1 (V=I*R1) is measured at pin 4 and sets the minimum voltage level (Vlo). The voltage across R2 (V=I*R2) plus Vlo set the maximum voltage level (Vhi) which is measured at pin 6. The current (I) is set by an internal voltage reference and the variable resistor R3. By properly choosing R1, R2 and R3, any voltage range can be set. I selected my resistors to turn the first LED on when the battery voltage exceeded 3.4 volts. This is 0.85 volts per cell which is the "fully discharged" value recommended for NiCds. I set the maximum level, when all LEDs are on, at 5.6 volts. This is 1.4 volts per cell, and is near the highest voltage a NiCd will normally be.

The LM3914 may seem like a simple voltmeter compared to the 3-1/2 digit LCD meters commonly used, but it is really quite accurate and it has much more versatility, making it ideal for a project such as this. The accuracy of the voltmeter is found by looking at the voltage range and number of steps: (5.6-3.4)/10=.22 volts per step, roughly ±2% of the 5 volt battery it is measuring. To achieve this accuracy, it is necessary to have the values of

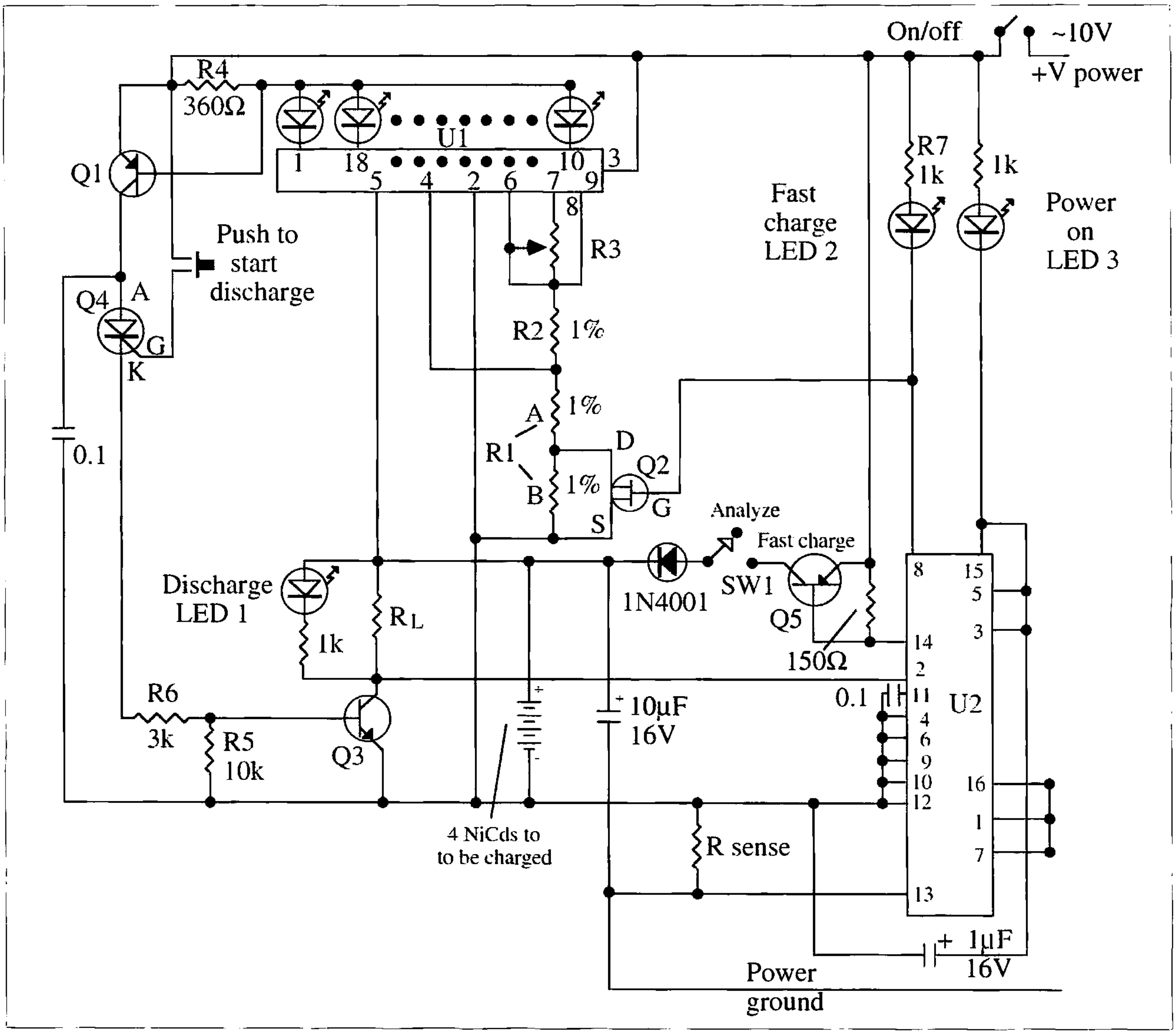


Fig. 1. The NiCd Health & Fitness Center schematic. Q1 = PN2907. Q2 = ZVNL110A MOSFET. Q3 = PN2222. Q4 = SCR EC103B. Q5 = TIP32 with heat sink. R1A = 2.94k 1%. R1B = 1.82k 1%. R2 = 2.94k 1%. R3 = 2k multiturn. Rsense = 1Ω 1W. RL = 33Ω 1W. All resistors 5% unless noted. U1 = LM3914. U2 = MAX713.

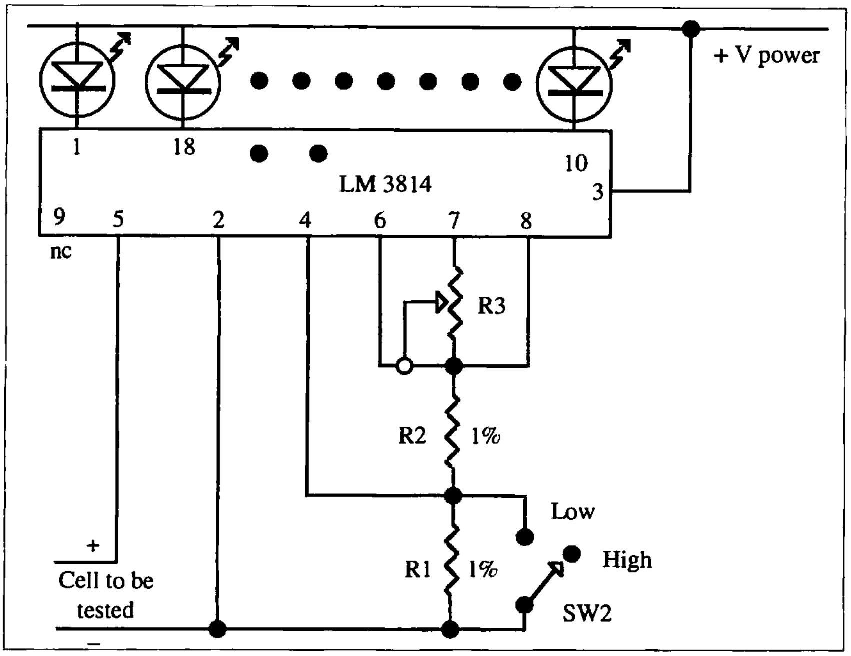


Fig. 2. The Personal Fitness Advisor schematic. R1 = 1.78k 1%. R2 = 2.15k 1%. R3 = 5k multiturn pot.

R1 and R2 be at least as accurate. I used 1% resistors for these resistors. The versatility of the LM3914 will become apparent when we look at the operation of the circuit in more detail.

U2 is a NiCd fast charger IC made by MAXIM. It is designed to permit rapid charging of NiCds without overcharging them. U2 runs in either a fast charge mode

Choose V lo, V hi, I1; then calculate resistors:
R3 = 1.28/I1
R1 = V lo/(I1 + .075)
R2' = (V hi - V lo)/(I1 + .075) This is a temporary variable to make calculating R2 easier.
R2 = R2' * 10/(10 - R2')
I1 is in milliamps
R1, R2, R2', R3 are in k ohms
V hi, V lo are in volts

Table 1. Equations to select resistors for a voltage range.

or the trickle charge mode. When it is connected to a battery it senses the voltage at pin 2 and, if it is greater than 1.4 volts (.35 volts per cell), U2 will enter the fast charge mode. This lower limit of 1.4 volts prevents U2 from putting a large amount of current into a possibly defective battery pack. The fast charge current (I) is set by Rsense (I = .25/Rsense). I selected a 250 milliamp charge rate which will fully charge AA batteries in three to four hours. When U2 determines that the batteries are charged, it will switch to a trickle charge so as not to overcharge them. The trickle rate is about 40 mA. U2 determines when the batteries are charged by using a method called voltage slope detection. When a NiCd is fully charged, the voltage will stop rising and actually drop a small amount before it again starts to increase due to overcharging. U2 will detect a voltage drop of as little as 2.5 millivolts and use it to terminate the fast charge. As a safety precaution, U2 will also keep track of the charging time and if a negative voltage slope is not detected within a set period of time (four and a half hours for our circuit) it will realize that there is a problem (the battery should have been fully charged in less than 4 hours) and will terminate the fast charge to prevent further damage to the batteries.

The rest of the circuit is best understood by looking at what happens when a discharge cycle is started with the discharge button.

Q4 is a silicon controlled rectifier (SCR) which is normally off. It is turned on when the discharge button is pushed and the gate (G) is pulled high. Once turned on, an SCR will let current flow from its anode (A) to its cathode (K) and it will continue to do so until this current goes to zero. It will then turn itself off, and stay off, until the push-button is pushed again. In our circuit, if the collector of Q1 is turned on and the SCR is on, current will be able to flow from Q1 through R5 and R6 to ground. This current will cause a positive voltage on the base of Q3, turning it on. Turning on Q3 creates a discharge path for the NiCds through RL. LED1 will also turn on, showing that discharge is occurring. In order to stop this discharge, it is necessary to turn off the SCR—here is where some of the versatility of U1 is seen.

As the battery discharges, the lower voltage will cause voltage-indicating LEDs to turn off one at a time from right to left. When the voltage drops below our minimum 3.4 volts all the LEDs will be turned off and discharge is stopped by Q1 which monitors the current to the LEDs of U1. As long as an LED is on, current will flow through R4, and Q1 will be turned on due to the emitter-to-base voltage drop across R4. As soon as all LEDs are off, the R4 current goes to zero and Q1 turns off. With Q1 shut off, the current flowing through the SCR stops and it shuts off. With no current flowing through R5, Q3 shuts off and the discharge cycle ends.

Pin 2 and pin 12 of U2, the MAX713, measure the voltage across Q3. During discharge Q3 is turned on, so the voltage across it is small. Recall that the internal circuit of U2 prevents it from going into a fast charge state if the voltage at pin 2 is less than 1.4 volts. U2 will be in a trickle charge mode passing about 40 milliamps. This current also flows through RL and must be accounted for in setting the value of RL. When the discharge cycle is done and Q3 turns off, pin 2 of U2 sees the no load voltage of the NiCds (3.4 volts in this case) and it initiates the fast-charge cycle. Battery voltage will rise rapidly for a while, and U1 will display this voltage change as LEDs start to turn on again. But even though the LEDs turn back on, Q3 will not start another discharge cycle, because the SCR has been turned off and it cannot turn on again until it is manually restarted by pushing the discharge button.

During the fast-charge cycle, the battery voltage will soon rise above 5.6 volts which is the upper range set for the voltmeter. To monitor this higher voltage it is necessary to shift the range of the voltmeter. This is done automatically by Q2 (a MOSFET). During trickle charge, the fast-charge indicator (pin 8) of U2 is in a high impedance state so the gate of Q2 is held high by the 1k pull-up resistor (R7) through LED2. This turns on Q2, which shunts part of R1 (R1B), giving a lower voltage at pin 4 and pin 6 of U1, since only R1A is in the voltage-setting circuit. During fast charge, pin 8 of U2 goes low to turn on the fast-charge LED indicator. This also shuts off Q2, and now R1B is added to the voltage level circuit of U1 and both Vlo and Vhi will be shifted higher by an amount equal to I*R1B. I set my higher range to be between 5.4 and 7.6 volts.

Charging current flows to the NiCd battery through pass transistor Q5. The control voltage at pin 14 of U2 adjusts the base current of Q5 to maintain a constant current flow to the battery. Q5 must be a transistor capable of handling at least the amount of current that the fast charge cycle is set for (250 milliamps in our case). More importantly in designing the circuit, it is necessary to determine the power loss in Q5. I initially powered my H&FC from a 12-volt power source. With a current of 250 mA to my four NiCd cells, the power dissipated in Q5 was (12-4)*.25 = 2 watts. I chose a TIP32 for Q5, which is capable of handling this power with a good heat sink, but I found even though I had a heat sink on the transistor, it got quite hot. I decided to use a 9-volt regulator to reduce the power dissipated in Q5 to (9-4)*.25= 1.25 watts. The regulator dissipates the rest of the heat (12-9)*.25=.75 watts. With heat sinks on both Q5 and the regulator, they both stay cool during operation.

The Health & Fitness Center is a useful project by itself but by building 2 more simple circuits using the LM3914 even more benefits can be realized.

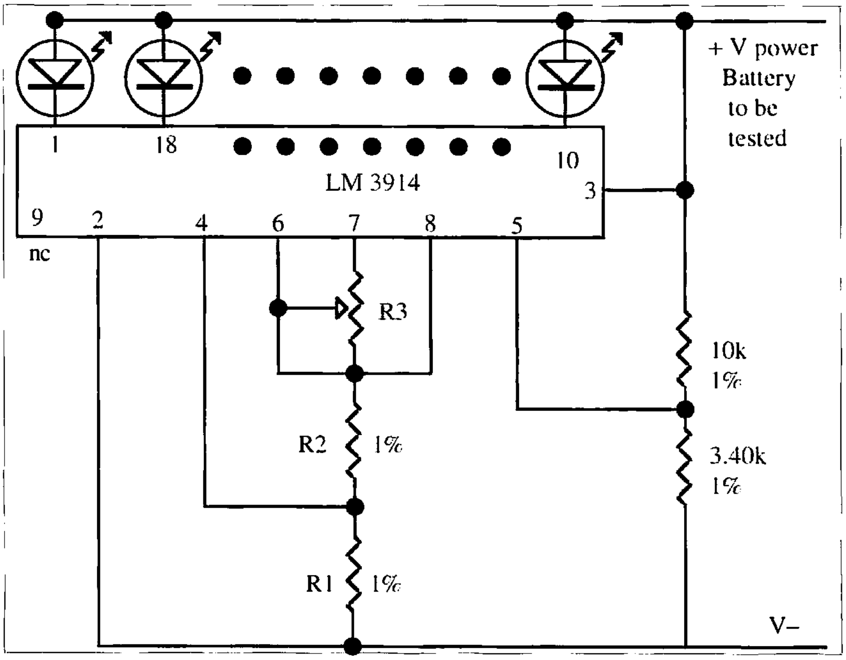


Fig. 3. The Tiny Fitness Tester schematic. R1 = 2.00k 1%. R2 = 549 1%. R3 = 5k pot.

The NiCd Personal Fitness Advisor (PFA)

Identifying weak cells within a battery pack requires a voltmeter capable of accurately measuring the voltage of individual cells. If a battery has a high internal resistance, it should be most obvious when the battery is under a load. I added a modified version of the LM3914 to my H&FC to let me check individual cell voltages during discharge and charge, to see if any are acting strangely.

Fig. 2 shows the circuit for my PFA. I wanted 100 mV accuracy, but also wanted to be able to test the voltage of a weak battery, both during discharge and fast charge. During discharge a weak battery is apt to be at a much lower voltage than the other cells, so I set the lower limit to 0 volts. During fast charge I wanted to be able to measure to 2 volts because a cell with a high internal resistance might get this high. Note that one of the safety features of

the MAX713 is that it limits its charging voltage to 2.0 volts per cell as a safety precaution. With healthy batteries no cell should be near this high value.

To be able to measure a range of 2 volts and still have the accuracy I wanted, I made the PFA a two-range voltmeter similar to the one in the H&FC. When the SW2 shorts R1 the lower range is 0 and the upper is 1 volt. When SW1 is open, R1 adds 1 volt to the lower range and the PFA measures from 1 to 2 volts.

Notice one other difference in this circuit. The LM3914 measures voltage relative to its ground. But in a multi-battery pack only one battery has its cathode at the system ground. To measure the other batteries, the ground lead of the LM3914 is actually at the potential of the battery cell below it. This causes a small additional current to flow through this cell, but I have set R3 in my PFA so that its total current is only about 10 mA. This current does not disturb the system and the PFA has no problem getting accurate readings of all cells. It is also why I used a manual switch for SW2 instead of connecting it to U2.

The NiCd Tiny Fitness Tester (TFT)

A third version of the LM3914 lets me accurately measure the batteries' voltage in the field when the H&FC is not available. It is the four-cell version of the Tiny Tic-Tac Tester I described in an earlier *73* project (*73*, March 1996). I built my tester in a breath mints box, which makes it very portable—it's small and needs no power source because it gets its power from the battery it is measuring. I carry mine in my shirt pocket and I can test my batteries anywhere quickly. With it I can avoid the embarrassment of having my batteries run down at a critical time.

Fig. 3 shows the TFT. Because the measured voltage must be at least 1.5 volts lower than the supply voltage, I use a voltage divider to halve the voltage to pin 5. One of the considerations in this version is to minimize power consumption from the battery being measured. This is done by selecting R3 to minimize the current out of pin 7. This current not only sets the voltmeter ranges as we discussed above, it also controls the current through the LEDs. LED current is controlled by the LM3914 to be 10 times the current out of pin 7 (that's why you don't need any resistors to protect the LEDs). For my tester I set R3 at 2.5k, which gives an LED current of 5 mA, and a total current draw of about 10 mA.

Building this project for a different number of cells

These three easy-to-build projects will help you get maximum life from your NiCds because you can:

- Measure your NiCd batteries' voltage accurately
- Fast charge them safely
- Discharge them correctly
- Look for weak cells
- Check them in the field

I have discussed only the four-cell circuit that I built, but it's easy to modify the design to accommodate many different battery configurations. **Table 1** shows the equations needed to modify the LM3914 for different voltage ranges. Note that for maximum accuracy, it is necessary to consider the resistance of the internal voltage divider of U2 and the additional current from pin 8 needed for the voltage reference (~75 microamps). *The ARRL Handbook* discusses programming the MAX713 for different conditions; it can be set to charge one to 16 cells, and for a programming time of 22 to 264 minutes. 73

The "Cobra" Antenna

It's got a more powerful bite than the "Rattlesnake."

Raymond A. Cook W4JOH
606 Georgia Avenue
Valdosta GA 31602

Gene Rhodes W4FNY, my friend for more than fifty years, has striven all the time I've known him toward the ultimate antenna. For the past several years, he had used what he called his "Rattlesnake" antenna, which transmitted an excellent signal from De Leon Springs, Florida. Recently he moved to Orange City, about seventeen miles from his previous QTH. Inexplicably, his "Rattlesnake" did not perform as well as it had at De Leon Springs.

He said he thought the ground system there was better, so I suggested that he run a heavy-gauge ground wire back to his old QTH. After some reflection, that solution was deemed impractical.

After weeks of frustration, he told me he wished that he could dream up something better. He likes to operate 160 meters, as well as the other bands, but his support poles were only 140 feet apart. Then one night, about 2:00 a.m., I awoke from a fitful dream with an idea buzzing around in my brain: Why couldn't the extra footage needed for 160m be made up by using *in series* the three wires (one white, one bare, one black) in Romex™ cable, the nonmetallic-sheathed cable used in house wiring?

I chose 14-gauge wire because of its lightness and low profile against the background of sky and trees.

This arrangement gives a flattop length of 420 feet, certainly ample for 160m. I had no idea exactly what would happen regarding impedance and frequency with the leads folded back upon themselves, but in our desperation, it seemed worth trying. The flattop dimensions and lead-in length were simply dictated by the limitations at Gene's QTH.

With the help of two fellow hams, Gene got busy acquiring the components and getting the antenna up. The following day he fired up on 75 meters for our regular schedule, after determining that his antenna gave him a 1:1 standing wave ratio on all bands. Lo and behold! His signal now was very strong (S9+) in spite of the fact that he was running only his exciter. Switching back and forth, he got greatly improved reports over the "Rattlesnake" from all who called in. I urged him to try the antenna using his linear amplifier, but he was afraid the high power might puncture the insulation of the flattop leads lying so close together. Finally, after several days, he held his breath and turned on the high power. What a beautiful signal—S9+30—and no arc-over! He immediately started calling the antenna the "Cobra," because it had a much more powerful "bite" than the "Rattlesnake."

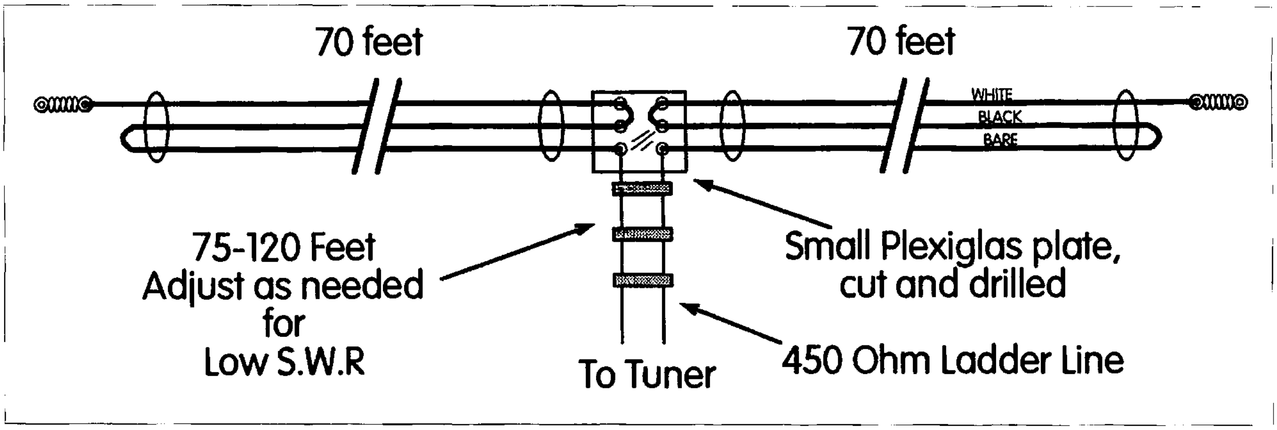


Fig. 1. The configuration for the "Cobra."

I then erected a "Cobra" at this QTH, using an Alpha linear, with the same results—because I, too, wanted to get on 160m. My previous antenna flattop was 108 feet long using traps. Emmett Bishop W4JVI of Athens GA, who regularly calls in, became excited about trying the "Cobra." He had been using two separate antennas of standard design, but his signal was often so weak (even with the linear) that Gene and Lloyd Goodwin W4FFD, in central Florida, could hear him faintly, or not at all, at that time of day on 75 meters.

After a few days, Emmett called in using his new "Cobra." His signal was S-9 with the exciter only, a far stronger signal than he previously had using both exciter and linear. Gene and I had checked the antenna out on other bands with excellent results, but Emmett had not yet had the opportunity to do so. This setup, of course, requires the use of a tuner for low SWR and efficient operation on all bands.

Some of our more skeptical, and perhaps knowledgeable, friends have expressed concern about impedance, power rating, wave-cancellation, etc. All that we can offer as an answer is the slogan used for many years by the Packard Motorcar Company: "Ask the man who owns one."

For years I have used the individual wires in three-wire conduit for antennas. At ten cents a foot, it's three hundred feet of antenna for ten dollars, or three cents per foot for the separate wires. Why not try this antenna? As Gene says, "I'm just tickled pink with the 'Cobra.'" Perhaps you will be, too. 73

WANTED

Fun, easy-to-build projects for publication in *73*. For more info, write to: Joyce Sawtelle, *73 Amateur Radio Today*, 70 Rt. 202N, Peterborough, NH 03458-1107

73 Review

Number 42 on your Feedback card

LDG's QRP Auto Tuner

Your dreams come true—in a kit.

Jeff M. Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

There has been one shack accessory I have been longing to own since I got rid of my tube rig—an automatic antenna tuner. I was very excited to get hold of a solid state rig and not have to load up the transmitter when changing bands. I have to admit it: I may be getting older (and lazier), but I never got much enjoyment out of fiddling with a bunch of knobs every time I changed bands. My first attempt at handling this problem was to get mostly resonant antennas. I have a five-band quad, a seven-band vertical, and a resonant dipole for 160 meters. I found early on that using my quad and a manual tuner I could also work 30, 40 and 80 meters. Not only could I work them, but I seemed to do quite well. The vertical also worked well, but on 40 and 80 you really need a tuner to go from one end of the band to another.

My next attempt at handling the problem of having to mess with a bunch of tuning knobs was to get hold of an older solid state tuner with a built-in automatic tuner. I ordered it, used, by mail. The rig worked great. I really loved it, but the tuner didn't work right. I managed to work a deal with the person I purchased it from and kept the rig, but still had no automatic tuner available. I thought it too expensive to get it fixed, and even if I got it fixed, I would have an older tuner that worked on only one of my many radios. I usually have at least six radios on line, hooked to three different antennas.

The folks at LDG Electronics solved my main problem: They came out with the AT-11, a 100-watt automatic antenna tuner. I was able to set it up to have all my rigs on line with all my antennas and use this one tuner. It's very fast and matches any of my three antennas on 10-80, and the dipole on all bands I have tested so far. It works for rigs down to about two watts and has exceeded all my expectations—and the best part was that I purchased the AT-11 in kit form. The kit is made up of excellent components and the matching case is very nice. I enjoyed putting the kit together as much as I've enjoyed using the auto tuner.

I work mainly QRP (low power) both on SSB and CW. I also love to work portable operation. I recently purchased a used Index Labs QRP+. This great little rig works 10-160 and has memories, SCAF filter and a built-in keyer. I purchased it mainly to take hiking in the Smoky Mountains. I love to pack up a rig, a small gel cell and portable wire antenna; I hike for an hour or two, and then set up my equipment. The thought of a small, low-power automatic tuner really got me thinking of how nice it would be to not have to mess with my old small manual tuner.

Hallelujah!

LDG's QRP Auto Tuner is offered as a kit or fully assembled. I bought the kit. It's a full-featured tuner that can be used either in automatic mode or semi-automatic mode.

In automatic mode, when you move around the band, or you change bands and the SWR gets too high, the auto tuner will start tuning. In semi-automatic mode when you want to re-tune, you simply push a tune button. The QRP Auto Tuner uses a switched L configuration with 256 capacitor, 256 inductor and Hi/Lo-Z settings to provide over 131,000 tuning combinations.

This tuner works well with about any coaxfed antennas (dipole, vertical, beam, etc.). Tuning time has been improved over the higher power version to between 0.1 seconds and 3.0 seconds with an average time of about 1.5 seconds.

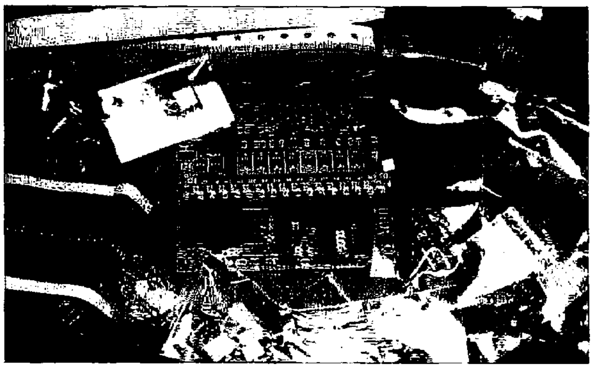


Photo A. Unassembled kit.

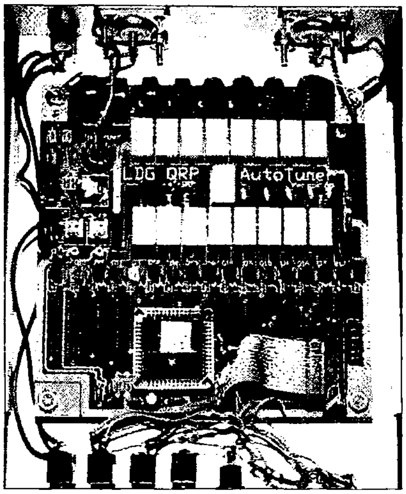


Photo B. PCB mounted in case.

The QRP Auto Tuner uses four LEDs to indicate the SWR status. Green indicates that the SWR is less than 1.5, green/yellow is 1.5-2.0, yellow is 2.0-2.5, red/yellow means 2.5-3.0, red indicates the SWR is over 3.0. There is a fourth LED used to indicate the tuner is in tune mode.

The kit

The QRP Auto Tuner kit is top quality in every sense. There are a lot of soldering joints, but many of them are the same value component, which meant I spent lots less time looking for parts. The parts came nicely packaged, and all parts were good quality. The printed circuit board was excellent. It was clearly marked and was plated through and solder masked. I got the optional case. I hate to drill lots of holes in a case when I am done building. The case makes the finished product look very professional.

The instructions were clear and easy to follow. There is a very nice parts overlay diagram that makes it easy to get the parts in the correct place. It is *very* important that you carefully read through the directions before building. There are some key areas that must be built in the described way or the unit will not work correctly. The included diagrams clearly show you how, but it is very easy to skim through the directions and not catch key details. LDG did a really good job with the instructions, and if you follow them the unit will work well.

After building the higher-powered version I opted to proceed a little differently from the directions—however, I followed every step exactly according to the cautions in the directions. I wound all the coils first. The directions for this were easy to follow. You will want to note the provided figures (Fig. 2, Fig. 3, Fig. 5 of the instructions) to make sure you wind the coils correctly. Note that with the first four coils you go through the toroid from the back, because the coil windings are all on the bottom. L5-L8 you start from the front. You wind them all in a clockwise direction. If you wind them wrong they will not fit correctly in the board. You don't solder these until later. I like this approach. I find I usually wind coils much better at the beginning of a project than when the whole board is ready to go and all you need to do is finish the coils. Also, please note the L8 is a double toroid. It uses toroids and you wind the wire around both of them—clearly explained in the instructions, but if you tend not to read directions completely, as I have sometimes done, you might miss this. The winding of the toroids must be done as described in the instructions.

Next, the directions tell you to mount parts on the board starting from

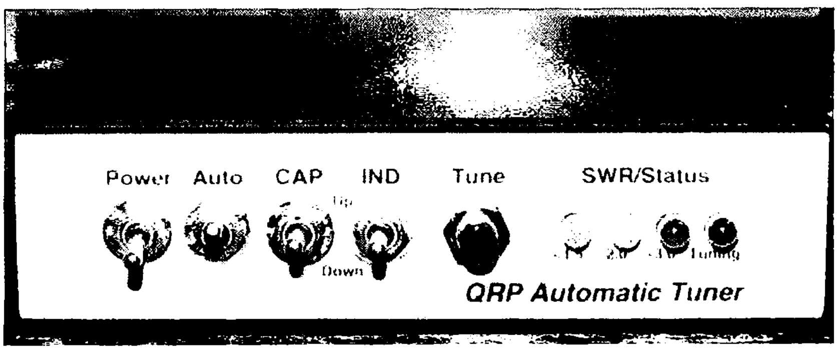
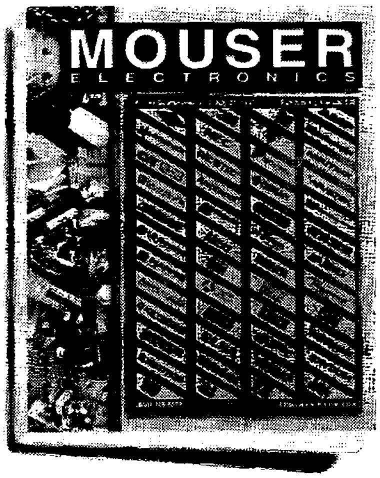


Photo C. Front view.



the components that are closest to the board. I usually like this approach. With this project there are some holes that are very close together and it wouldn't be too hard to accidentally fill the nearby hole with solder. For this reason I started with the components under the bottom row of relays. If you look at this section there really are sets of three components that repeat across the board. There is a 1k resistor, a 0.01 capacitor and then a 2N3904 transistor. I stuffed these in the board and soldered in sets of three, checking each set before proceeding. I followed the rest of the directions pretty much as they were stated.

Once you have placed and soldered all the parts, you test the unit without the processor chip installed. The chip is the most expensive component, so I liked this idea. You need only check for +5 volts on the output of the 78L05 regulator. If the volts look good and the unit isn't pulling too many amps you stick in the chip and turn on the power. If everything is OK, all the LEDs blink once to let you know the unit has checked itself out.

The alignment of the unit is very simple. You only need a voltmeter. You simply apply 5-10 watts into the unit and zero the voltage using a variable capacitor. Once this is done you set both the forward and reverse voltage to 2.5 volts at the specified test points. The whole process can easily be done in a few minutes. After I got done with the alignment and was pretty sure things were doing what needed to be done, I glued down the first four coils as suggested and also put a dab of epoxy on the LEDs to hold them firmly in place. I then put the case top on.

Testing the tuner

I took the little QRP Auto Tuner over to my workbench and took my connections off the tuner's bigger brother, the AT-11, and prepared for testing, using a small 12V gel cell for power. My workbench setup allows me to choose any of six transceivers and match it with any of my three antennas. For initial testing I used my 160 meter dipole, my Gap vertical, and my Lightning Bolt 2-element, 5-band quad (10-20 meters).

I used five watts and keyed up. The QRP Auto Tuner was set on automatic mode, so that when you key up, if there is an SWR mismatch, the tuner activates. The relays clicked for less than one second and matched the 160 meter antenna for 40 meter operation. I was able to tune this dipole (resonant at about 1. 850) to all amateur bands. The tuner also tuned the Gap vertical to all bands, including 160 meters. It tuned the quad to all bands down to 80 meters. I played with the unit and if the SWR was less than 1.5:1, I was able to use the capacitor and inductor switches to get the SWR pretty much down to close to 1:1.

X-treme test

This is the kind of a story I live to tell. My goal in building LDG's QRP Auto Tuner was to be able to use it with a small dipole I use when I'm hiking. The antenna has been cut to be a resonant dipole that covers the 20-meter band. I used a six-by-six inch piece of Plexiglas™ as my center insulator (and wire holder). I used small cloth-wrapped stranded wire that tends to be kink-resistant for the antenna. For the coax I used very small RG-178 coax. Both legs of the antenna and the coax wind nicely around the Plexiglas while I am hiking and allow me to set up the antenna very quickly when I arrive at my destination.

I took the antenna and set it up in the middle hallway of my house, the worst in-the-house location I could think of. The antenna was hung approximately four feet off the floor with the wire just draped over two doors. I brought the coax into the shack and hooked it up to my TenTec Argosy II. I powered the Argosy with a small gel cell and was in QRP power range.

The weather here in Tennessee was awful—heavy rains and severe thunderstorms. The bands were horrible, with lots of static crashes and not many stations on. I went through the bands from 80 to 20; the only stations I heard were on 40. I keyed the transmitter and in less than one second the dipole was tuned. I looked around for a while for a station calling CQ. I finally came across Dan K9EUV, in Mishawaka, Indiana. He was a 599, and gave me a 339 report. I admit we didn't have a long QSO, and he did have trouble copying, but we exchanged calls, names and QTHs. Considering the power I was using and the antenna strung up in the middle of my house, I still have no idea how I got out.

I checked the SWR on 20 meters with my MFJ antenna analyzer. The SWR in the house was over 5:1 to start with. The little QRP Auto Tuner had no problem tuning the twenty meter dipole on 10, 20, 30, or 40 meters. It tuned each of these bands in less than one second. I am really looking forward to taking this tuner, my QRP+, and the dipole hiking. I'm sure I'll have no problem once I get on top of the mountain. This auto tuner is much smaller and lighter than the manual tuner I've used in the past.

Bottom line

I am very impressed and more than satisfied with this tuner. The QRP Auto Tuner tunes more quickly than the AT-11 version in all tests I have performed. It was a great kit to build and it works fantastically.

To order, contact LDG Electronics, 1445 Parran Road, St. Leonard MD 20685. Phone (410) 586-2177; [ldg@radix.net] or [http//www.radix.net/~ldg], or send $100.00 for the kit, plus $6.00 shipping (US and Canada) to LDG's sales department ($125.00 plus $8.00 for the kit with enclosure; $159 plus $8 shipping for the already-assembled model).

Specifications:
- Size: 4.4 x 4.3 x 0.6
- Weight: 4.2 oz.
- Configuration: Switched "L" network
- Inductor range: 20 µH
- Capacitor range: 2700 pF
- Tuning time: 0.1 to 3 seconds, 1.5 average
- Current consumption: 10 to 190 mA, 75 mA average
- Voltage requirement: 11 to 14 volts
- Microprocessor-controlled
- 30.0 MHz coverage
- Tunes 6 to 800 ohm loads
- Power range: 0.1 to 10 watts
- For dipoles, verticals, vees, beams or any coaxfed antenna
- Kit builds in 2 to 4 hours (average)

Number 45 on your Feedback card

73 Review

ICOM IC-R100 Communications Receiver

It may look like a scanner, but it is a serious communications receiver with scanning capability.

Breckinridge S. Smith K4CHE
104 Brookfield Drive
Dover DE 19901

I like scanners, but my wife is obsessed with them. She has two in place on the kitchen table, one to monitor the community and another one to keep track of the police departments and my ham activity. It's a regular scanner world in our kitchen. The last time the President visited the nearby Air Force Base, our kitchen sounded like a military command post.

I searched all of the advertisements for a small receiver/scanner with good sensitivity, a VFO, and an S-meter. These specifications were needed for my foxhunting sessions using Doppler systems and conventional directional finding antennas.

I had a lot of trouble getting some of the manufacturers to fess up on their sensitivity specifications but ICOM specs were clearly stated in their spec sheet. So I ordered the unit and received a small (5.9 inches wide, 2.0 inches high and 7.1 inches deep) unit that conformed to my specifications, as well as featured a built-in 20 dB attenuator and a preamp. Throw in the wide 500 kHz to 1800 MHz coverage and you have quite a unit. Yes that's correct, that's 500 kHz, which is down below the AM broadcast band, up to 1.8 GHz, which is in never-never land. Now *that's* coverage. The standard receiver coverage is continuous and covers all the amateur bands including HF, VHF, UHF up through 1296 MHz. The unit, as supplied, does not cover 800 to 900 MHz—there is a special law enforcement receiver that can be ordered by authorized agencies that covers 800 MHz.

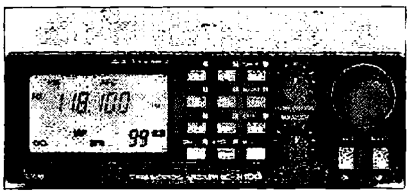


Photo A. The ICOM IC-R100.

I unpacked the unit in the kitchen while my wife eyed it from across the room. Was she thinking of a third unit to add to her inventory? She doesn't know about the predicted frequency move of our local agencies from VHF to the higher frequencies—I know *your* area agencies have already moved from the lower bands to 800 MHz or higher, but I must remind you that I live in the technical black hole of the East Coast—Delaware.

Initial examination

The first thing you notice is the 3.1-pound weight; the unit feels hefty. The entire enclosure is steel, not plastic, and on the rear are three antenna connectors. Remember, I told you that this is a serious receiver. Two N connectors for the 50.0 to 905 and the 905 to 1800 MHz range: You need two antennas for these ranges. The third connector is an SO-239 and is for the lower frequencies of 0.5 to 49 MHz. The antennas

supplied were a small telescoping whip with an N connector, and a short portable longwire HF antenna. After further examination of the rear panel I found the standard 2.1 mm power plug. The center pin is positive (don't you hate it when they make the center pin negative?), and a quick check of the service manual tells me that the unit has reverse polarity protection via a diode. There's an internal speaker mounted on the bottom, but the unit has an external speaker jack which utilizes a 3.5 mm plug. In addition there is an antenna select jack which uses a 3.5 mm stereo plug. The rear panel also sports an LCD contrast pot and a clock display option switch. The data plate is riveted to the chassis. The power cord is fused on both sides (don't buy equipment that is not fused on both lines—I can tell you some horror stories!). ICOM provides a chassis-mounted metal cable clamp to keep the power cord secure. The mounting bracket supplied is rugged and secures the unit with four screws.

The biggest item on the front panel is the large 2- by 1-inch LCD display. There is a no-nonsense dimmer button that is easy to activate. The keys on the keyboard are covered with that magic rubber and the function labels are printed on the rubber. The actual key numbers are printed on the front panel. Key activation is signaled by a beep (which can be disabled). The squelch and volume knobs are much smaller than the large VFO/channel knob, which is normal-sized. Below the VFO knob are two push-buttons which are labeled timer and sleep. At first, I thought "What a waste of panel space," but these buttons are also labeled DN and UP and allow you to change the frequency or channels up and down if you get tired of the large VFO knob.

Sensitivity and frequency coverage

My first bench check was for sensitivity. If the unit doesn't pass, it goes back. On two meters the specs called for 0.2 µV using 12 dB SINAD. I measured 0.1 µV without the preamp. The squelch opened at .07! This was without the preamp on; turning on the preamp on two meters did not really improve the 12 dB SINAD sensitivity, but the S-meter indicated an increase in signal strength. The sensitivity passes and the unit stays. My Doppler systems and other DF gadgets on my communications van are going to be very happy with this receiver! Further sensitivity checks on 220, 440, 906, and 1296 all beat the specs, but the preamp has to be on for the higher UHF frequencies—above approximately 500 MHz—to meet the specs. On its spec sheet, ICOM clearly states that the preamp must be on to meet specs between 50.0 and 905 MHz. The preamp is not available above 905 MHz, and you have a slight rise in the 12 dB SINAD specification level from 0.2 µV to 0.32 µV on FM which results in the receiver sensitivity being slightly reduced. I spot-checked the FM sensitivity at 1550 and 1750 MHz and found it to be better than the specification of 0.32 µV.

> ***"Remember, I told you that this is a serious receiver."***

Unit operation

Setting in a basic frequency and mode was simple, but you have to be careful with the selection of the mode. It's easy to confuse the wide FM with the narrow FM. Wide FM would be used on the FM broadcast band or in the audio portion of TV broadcasting, but not on two meters. It took only a moment to program the channels, but the best part is that you can erase the channels completely without resetting the central processor. I was eager to try out the VFO and found that the tuning step range of the VFO was easy to change. The selectable steps are 25, 20, 12.5, 10, 9, 8, 5 and down to 1 kHz. I was looking forward to the 1 kHz steps, which are needed for foxhunting when the fox sometimes shifts, either accidentally or on purpose, off frequency in small increments. The mode and step setting are programmable with the channel frequency and it's easy to select a channel and then tune up or down in small frequency steps from the channel that is selected. The first week that I had the unit I drove around town tracking down cable TV leaks for DF practice. With the IC-R100's VFO it was a snap. During my tour of the city I drove through several of our intermod alleys and found the receiver to be reasonably immune to overload as compared to the other (cheaper) scanner mounted in the vehicle.

More receiver features

The attenuator is selectable with a push-button and provides approximately 20 dB of attenuation. This is very useful near strong broadcast stations, repeaters, and when closing in on the fox during a hunt. This feature is available only on the 50 MHz to 905 MHz range.

The AFC (Automatic Frequency Control) tracked very nicely. I set the unit on the bench and slowly moved the signal generator away from the frequency and the unit tracked it. Perfect for that foxbox or balloon transmitter that drifts in frequency, due to low batteries or extreme temperature change.

The antenna selector jack is located on the rear panel. The instruction book was vague on this function but the purpose of this jack is to provide a high or a low voltage logic signal depending on the frequency that is being covered. This logic signal will be used for activating other antenna selectors remotely. The instruction manual didn't include a table of voltages but it was easy to figure out.

The unit has a clock which can be displayed on the front panel if desired and you can program the unit for various timing functions. Available are power on, power off, or a memory select timer. You can have a once-only timer, a daily timer, a sleep timer—the list goes on. The clock has a backup battery specified to last one and a half years, and it's fairly easy to access the clock battery, as it is located on the main board, near the rear of the receiver. The central processing unit also has a battery that has a predicted life of five years and ICOM recommends that the receiver be serviced for this battery change as the battery is buried in the logic board area.

The S indicator is a bar graph with seven easy-to-read segments. It is a relative signal strength indicator, and is not calibrated in S units. During the factory alignment, the S indicator is set at a specific signal level in the 80 MHz range. A three-segment signal indication on VHF is not the same as a three-segment signal on UHF—I found that for three segments, on two meters it took 1.5 µV, and on UHF it took a much stronger 7 µV volt signal.

I took a break from the test bench and put a wire antenna on the HF antenna port.

Tuning down across the 40-meter AM broadcast band was a treat! I had forgotten about the hundreds of stations broadcasting from all over the world. A quick check on 40-meter SSB and CW produced signals with the receiver, but they were hard to interpret as the unit does not have a BFO or product detector. Tuning across the AM section of 75 meters produced several good signals. Checking the time and frequency standard, WWV produced strong signals in the 10 and 15 MHz range. While mobile, I used the ANL, automatic noise limiter, on WWV, and found it to be effective with pulse-type noise.

Back to the bench

The ultimate test of a scanner: The Birdie Search. The search is conducted without an antenna for signals that are produced by internal mixing of various oscillators and IF circuits inside the receiver. Nothing is worse than band-scanning and having your unit lock up on one of these internally generated signals. My first problem: How do I check the receiver from 500 kHz up to 1800 MHz? That's a lot of knob twisting. What I did was program the unit to search small frequency segments at a time, and to stop and resume scanning. I activated the Auto Memory Write Scan mode; this way the receiver would search itself and write any detected birdies into channels 80 through 99. I went back later to check the results. I did find a few, but very few—one well below two meters on 141.2 MHz and other significant signals at 105.9, 176.5 and 211.8 MHz, but not enough to worry about. There were no birdies in the amateur bands; this unit is very clean and passes the birdie test. The auto memory write mode worked very well and is great for searching with an antenna for those secret frequencies out there.

800 to 900 MHz is locked out of the receiver. Now, I know that some of you want to know about the possibility of modification, to receive this range for monitoring local government agencies. Since I do two-way radio service work on the local trunking channels, I needed the extended coverage to monitor our systems. I modified the unit using one of those modification books that are available at hamfests. The modification wasn't easy and involved a complicated disassembly of the unit to be able to find the correct area of the logic board. Once you find this area you have to remove several surface-mount components surgically. The modification is definitely not a clip-the-diode or jumper type of operation.

The instruction manual is well written and provides several quick reference sections. A schematic of the unit is not included. ICOM promptly sent me a service manual for review; it was well organized and included all the schematics. During my review of the service manual I stumbled across this "Danger" statement: *"Do not apply an RF signal of more than 100 mW (that's one tenth of one watt) to the antenna connector. This could cause damage to the receiver front end."*

With the IC-R100's VFO, tracking down cable TV leaks was a snap."

I did some field strength calculations but was not sure of the near-field formulas so I tested my scanner receiver antenna mounted in my van. It was very easy to induce a 100 mW signal into my scanner antenna from a nearby 50-watt quarter-wave antenna. Most of my power levels on my vehicle are in the 10- to 25-watt range so I was fairly safe. My advice is to mount your scanner antenna as far as possible from any transmitting antenna—this is good advice for *any* two-way installation. Separate those antennas!

Overall

It's obvious that I like this receiver. My only complaint is that the unit has too many features crammed into the little steel box—but all the features work, and the unit surpasses its published specifications. I have used the unit extensively for my two-way radio service work and for my foxhunting obsession. I don't think that you will be able to find another small mobile receiver that has the frequency coverage, a VFO capable of 1 kHz increments, and a preamp and attenuator built-in.

MSRP for the blocked version of the IC-R100 is $960. For further information, contact ICOM America at 206-450-6088 or your nearest ICOM dealer.

73 Review

The Standard C108A

It's the smallest amateur HT available today.

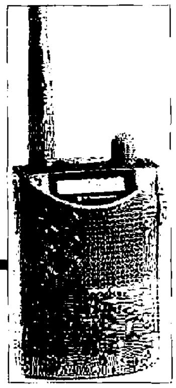


***Photo A.** Standard's C108A.*

Dean Lewis WA3WGV
1193 Azalea Lane
Palatine IL 60074

Two-meter ham radio hasn't been this much fun since my first Heathkit "Twoer," over 30 years ago. Owners of Standard Amateur Radio's C108A pocket-size two-meter HT already know that the rig *really* fits in a shirt pocket, has excellent sensitivity, and is easy to use. I agree with those who say it doesn't replace a higher-powered unit in all cases, but don't let the 230-milliwatt transmit power deter you from getting one. It does work local repeaters, has excellent transmit audio, and the small size (only slightly larger than a pager) means you can take it with you everywhere. The following suggestions are based on over a year of successful use of the C108A; some should also apply to Standard's dual-band version, the C508A.

Operation

The 7 buttons (called "keys" in the owner's manual) are easy to operate. We're used to instant response from push-button switches, so the Power key takes a little getting used to; it must be pressed and held for a fraction of a second before the unit turns on. After a while you develop a routine for handling the rig without hitting any keys when clipping it to or removing it from your belt.

The belt clip is an extra-cost accessory. If you buy the soft case and belt clip at the time you buy the radio, I'd suggest not using both at the same time for a few days, until you get used to the button functions. They're not printed on the soft case, and with the clip installed, it's difficult to slide the case down to see the labels next to the keys. After a few days' use, the functions become intuitive. While on the subject, a word about the belt clip. Although stronger, heavy-duty, and non-rotating, it's similar to a speaker-mike clip. It clips onto your belt, not around it like a pager or most HTs. It's very secure, and does not slide.

Scanning is an excellent way to find new repeaters and popular local simplex frequencies. No matter what portion of the radio's broad frequency coverage you want to scan, you'll appreciate the two types available, defined by how long the receiver stays on an occupied frequency before moving on.

If you move around a lot from one end of the frequency range to the other, you'll soon catch on to a method for doing it quickly: switch to the largest (50 kHz) tuning step before dialing to the new frequency, then switch back to the step desired for scanning or tuning within that frequency range.

Rather than an analog knob for setting the squelch, three squelch positions are programmable and are easily changed: high, low, and off. The high and low designations are opposite to what I would have termed them. Think of it this way: the high setting requires high signal strength to open the squelch; at the low setting, even low level signals will come through. I initially had misgivings about the automatic squelch settings, but those doubts were quickly put to rest. I don't know how it's done, but the "low" setting is every bit as sensitive as a manually-set squelch control; if the squelch does not open, you can be assured there's no usable signal there. Provision is made for manually overriding the squelch if you need or want to. Now I wish all HTs had the automatic feature—one less control to mess with.

Once you've programmed the memories, dialing through them is enhanced by a beep at memory location zero—very handy when you can't be distracted by watching the readout, such as in a dark location (although the backlight can be switched on) or mobile with the rig on the seat next to you. From the beep, count the knob detents, and you know which memory position you're on.

The 108 doesn't include an S-meter. This has caused some owners concern when trying to identify the exact frequency of a strong signal, either simplex or an unknown repeater. But a very strong signal which appears on more than one frequency will appear on an *odd* number of frequencies; the center position is the true received frequency.

Frequency coverage

Although the unit transmits only in the two-meter ham band, it receives from 100 MHz to 174.995 MHz. This includes some interesting territory—aircraft, marine, the Coast Guard, public service, police, fire departments, and NOAA weather radio. In addition to giving you tomorrow's forecast, the NOAA signals are good for catching band openings during the tropo season.

The owner's manual does not explain AM reception. The 108 automatically switches to AM from 100.000 to 138.330 MHz, and a decimal point appears in the readout to the right of the last full-size digit, a "10 kHz dot" in the nomenclature of the manual. There is a dead band from 138.335 to 139.995 MHz, in which no signals can be received; the readout flashes on and off to warn of this condition. AM cannot be enabled elsewhere in the range of the 108's frequency coverage.

Antennas

The 108's antenna connector is an SMA type, due to insufficient space on top of the radio for a BNC. You'll need

an adapter if you plan to connect any BNC-fitted cables or other antennas. Shop around; I found prices for an SMA-to-BNC adapter varied from around $30 (!) down to just under $7. Whenever using the adapter, be careful to avoid mechanical strain on the antenna fitting or the top of the radio. Connect the adapter's BNC end to the antenna before threading the SMA end onto the HT, and match the threads carefully.

Your choice of antennas at any given time will be determined by the need at the moment. The antenna will configure your 108 for either (1) effective communicating, or (2) carrying convenience. These are described in the paragraphs following. The rubber ducky supplied with the radio is a compromise between the two.

(1) Many of us use a 2-1/2 to 5 watt HT feeding a short rubber ducky, whether for simplex contacts or through local or medium-range repeaters. If better range is needed, we get an HT (or battery) with more power. Bad logic. The antenna is just as important at 2 meters as it is at HF. Sure, a 4-inch "stubby duck" is convenient and it will make contacts, but to get the most out of a 1/4-watt HT, get used to using a better antenna. Connecting a telescoping endfed 1/2-wave (an AEA HR-1 "Hot Rod") made a tremendous improvement in both my transmit and receive coverage, and it made the difference in my satisfaction and success with the 108. But be careful handling the radio with a long antenna connected. The fitting and the top of the radio are not built for the kind of mechanical strain you can cause. Keep the radio upright, protect it from tipping over, and don't walk around indoors (or outdoors under trees) with the antenna extended (and, as with any HT, don't make yourself a lightning rod outdoors in threatening weather).

I've also had great success with a trunk-mounted 5/8-wave for mobile use, even at this low power level. For travel with a rented car, a small mag-mount 19" whip was recommended to me by another owner who was very satisfied with the results.

(2) At the other end of the antenna size range, shorter models are best for carrying the HT, and will make the most of its small dimensions. "Mini-ducks" available from several suppliers (Comet CH-32, Diamond RH-3, Optoelectronics DB-32; possibly others) are 1-3/4" long, including the BNC fitting. You have to use an SMA/BNC adapter which adds a bit to the length, the antennas are not flexible, and they're often referred to as dummy loads. They are, however, very convenient when carrying the HT on your belt. They work surprisingly well for receiving, and they're great for Field Day or hamfest simplex—you can even work repeaters if you're close enough. More recently, these mini-ducks have become available with SMA fittings (Comet SMA-501, Diamond SRH-805), and don't require the SMA/BNC adapter.

For even greater convenience when just carrying the rig, disconnect the antenna, put it in your shirt pocket, and screw an SMA cap on the 108's antenna fitting. At this point the radio is as convenient as a pager (and is often mistaken for one), the antenna jack is protected from dust, moisture, and any stresses from the antenna, and the antenna itself is protected. If you're going to carry the rig in a coat pocket, especially in bad weather, this is the way to do it. Remember not to transmit without an antenna connected!

Batteries

The C108A runs on two AA-size batteries. They last a long time in receive; I run name-brand alkalines for several hours a day for over a week between battery changes. Transmitting time has, of course, a significant effect on battery life. It's a good idea to carry spares. Radio Shack carries a white plastic battery clip for two AA cells, the type that has a 9-volt style connector at the top (part number 270-382). Remove the metal hardware, and the plastic holder keeps the two batteries together and protected from shorting out on metal objects.

Batteries too depleted for transmitting often have plenty of life left for receiving. It can pay to hold on to your weakened batteries for additional hours of monitoring.

I'd recommend buying the protective soft case for the radio. Besides protecting the unit, it helps keep the battery cover in place, especially when clipping it to your belt or removing it. The more recent, dual-band C508A has a lock on the battery cover which the 2 meter-only version doesn't.

Yes, I do own a higher-powered HT, but the C108A is the one that's always within reach. It's about the size of the mike that came with that old Twoer.

Note: SMA caps are very difficult to find. I had to buy a quantity in order to get one, and can supply them for $5 each.

The Calibrated Hula Hoop

Keep your radiation within the new FCC limits.

R.W. Vreeland W6YBT
45 Maywood Drive
San Francisco CA 94127

What's a ham to do? The new FCC regulations require that hams running more than 50 watts PEP must conduct a routine RF radiation evaluation to ensure that the radiation is within the maximum permissible exposure limits. A spectrum analyzer with calibrated antennas can cost many thousands of dollars—but it is my understanding that the measurements need only be accurate enough to ensure that the limits are not exceeded. This leaves a lot of leeway in most cases.

At W6YBT, we use only indoor antennas. For this reason, the new FCC ruling is of special interest. So what should I do? In general, I don't like the hand-held E field meters. I once had one that measured the 60 Hz fields from fluorescent lights when it was *supposed* to be measuring RF. The secret of measuring the field strength close to a transmitting antenna is to measure the magnetic field, not the electric field. This is done with a loop antenna.

The requirements for a loop antenna suitable for RF radiation evaluation:

1) Use only passive components. We don't want an unstable RF amplifier or a drifting DC amplifier.

2) The unit should be easily duplicated by other hams.

3) Since the loop's sensitivity is determined by its dimensions, only the sensing unit needs to be calibrated. This can be done with an ordinary laboratory signal generator.

Construction

Go to a toy store and buy a standard 79 cm diameter hula hoop. Get the cheaper one with the three ball bearings inside, not the one that can be converted into a jump rope. Remove the staples and the center plug but don't cut off any of the tubing. Next, cut a 98-inch length of RG-8/U and remove a 1 cm section of the braid at its center. This break in the braid permits the sensing of magnetic fields while retaining shielding from electric fields. Loops always measure the magnetic field. They are, however, usually calibrated to indicate the equivalent electric field in volts per meter.

Now thread the RG-8/U through the hula hoop and install PL-259 connectors on both ends. Cut about a quarter of an inch off each end while installing the connectors. Be careful to make good solder connections to the braid (you will need a 100-watt soldering iron for this). After soldering, take some alcohol and clean off all the rosin. Even a small contact resistance can result in erratic readings.

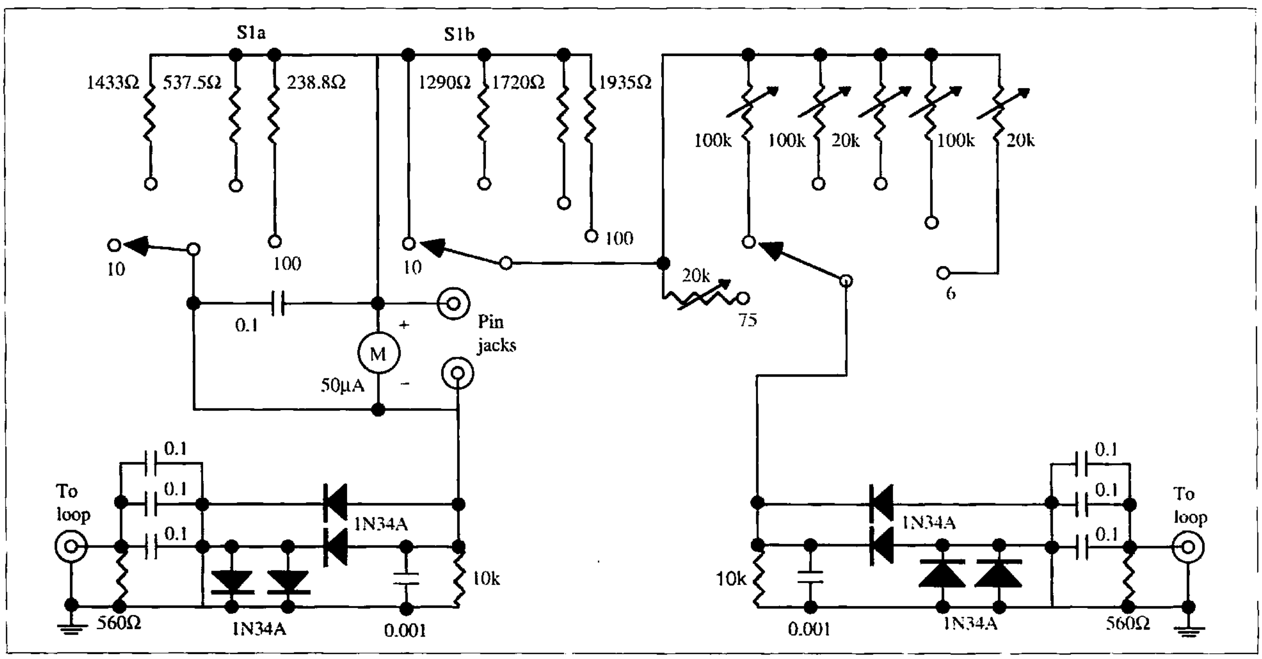


Fig. 1. Only passive components were used—no batteries to replace!

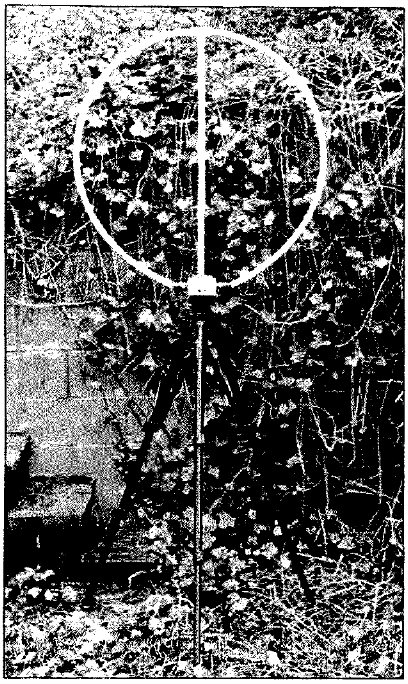


Photo A. The box mounted on the camera tripod.

When the loop is completed, the hula hoop should just cover all of the black jacket on the RG-8/U—it is important that you follow these dimensions exactly. The sensing unit is built into a Bud™ CU-234 die-cast aluminum box. I installed SO-239 connectors to support the loop. Be careful not to run any rosin into the connectors; they permit the loop to be removed for calibration of the sensing unit.

I bolted a piece of white three-quarter-inch PVC pipe to the rear of the box, and inserted a short piece of three-quarter-inch dowel into the end of this pipe to prevent the screws from mashing it. At the upper end of the pipe is a tee through which the hula hoop is threaded (the inside of the tee had to be filed to permit the hula hoop to pass through). As a final touch, I drilled and tapped the box for a 1/4 - 20 screw to mount it on a camera tripod (**Photo A**).

The circuit (**Fig. 1**) uses a 50 microampere meter (Micronta 270-1751). It is shunted to provide four sensitivity ranges. In order to provide a constant load, the range switch also adds series resistors. I used ordinary quarter-watt resistors selected with a digital ohmmeter. The odd values were made by connecting two resistors in series. Be careful not to overheat the resistors when soldering.

The shunt values were calculated for use only with the 2150Ω Micronta (or other 2150Ω) meter. Unfortunately, Radio Shack™ no longer sells this meter. The Simpson 1227 50μA meter is a suitable but more expensive substitute. You should add a 350Ω resistor in series to bring its 1800Ω resistance up to 2150Ω.

A major problem was getting sufficient

Band	75	40	20	15	10	6
Cal. Volts	0.55	1.28	1.72	0.64	1.22	0.33
Trimmer R	10.6k	43.6k	65.9k	15.7k	40.8k	4.0k

Table 1. Reference points that you can use for approximate calibration of your hula hoop. An ordinary laboratory signal generator will provide a standard calibrating voltage point for each band.

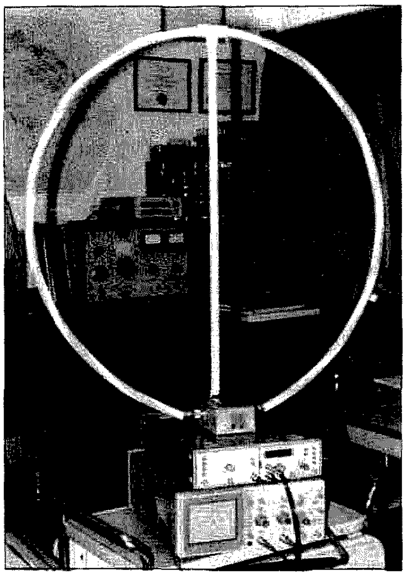


Photo B. Calibration was done by substituting the hula hoop for a standard calibrated loop located on top of a spectrum analyzer. The signal generator in the background was used to establish a calibration reference point for each band.

sensitivity on 75 meters because loops are always less sensitive at lower frequencies. This required the use of capacitors and clamping diodes in addition to the conventional half wave rectifiers. The diodes were selected for high back resistance using the x100000 scale on my Triplet 630A meter—I threw away any diode that measured below 1 megohm. Use a clip-on heat sink to avoid overheating the diodes when soldering.

A separate calibration trimmer potentiometer is required for each band due to the differences in loop sensitivity. I ordered the Spectrol trimmer potentiometers from Mouser™. You will need three of the catalog number 594-70Y203 and three of the 594-70Y104. The switches came from Radio Shack. They are 275-1385A and 275-1386A. All of the capacitors are 500 volt or 1kV ceramic discs.

Calibration

Preliminary calibration was done with a spectrum analyzer and a calibrated loop. I used my Yaesu FT-757GX and my indoor antennas as a signal source (**Photo B**). First, I took a reading with the standard loop on top of the spectrum analyzer before replacing the standard loop with the hula hoop and setting the calibration potentiometer for that band. Due to the complicated field distribution inside the house, this calibration was only approximate. For the final adjustment, I used outdoor wire antennas.

After calibration, I removed the loop from the sensor unit and connected my signal generator and a 6 dB splitter in its place. The splitter output ports must both be terminated with 50Ω loads. I then determined the signal generator output required to give a reading of 10 volts per meter on each band (see **Table 1**). You can use them for calibration of your sensor unit. I have also listed the approximate trimmer settings for each band. Be sure to switch out the trimmers before measuring their resistance. You'll most likely prefer the signal generator method of calibration because it will enable you to correct for differences in diode characteristics. The trimmer settings will not.

The response is nearly linear. However, the line doesn't pass through zero, so use the graph (**Fig. 2**) for accuracy. If you are an artist, you might want to calibrate the meter face. I chose meter ranges of 10, 25, 50, and 100 volts per meter, since it is best to read only the upper half of the meter scale. The calibration trimmers were all set in the upper portion of the 25 V/M range in order to provide the best accuracy for the FCC 27.5 volt per meter limit for uncontrolled environments. Don't use the calibration graphs with the 50 or 100 V/M scales—reading the meter scale directly will give better accuracy.

It is unlikely that you will use them anyway. The highest reading that we were able to get from a kilowatt with a beam was only 10.6 volts per meter. I should emphasize that this is not intended to be a precision instrument. It is most useful for measuring signals that are well below the FCC limits. If you get a high reading, use a more precise instrument or better yet, locate and correct the cause of the high reading.

Extending the frequency range

Due to the high distributed capacitance of RG-8/U the hula hoop will not work on 10 meters. A small loop made from a 35-3/4" length of RG-8/U

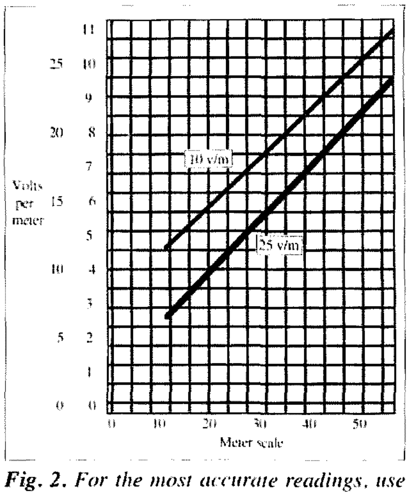


Fig. 2. For the most accurate readings, use these calibration graphs or calibrate the meter face.

(measured from tip to tip of the center conductor) works well on both 10 and 6 meters. It is self-supporting—I mounted the two additional trimmer potentiometers in the front of the box with access holes near the meter.

Measurements vs. charts

Actual measurements indicate that the indoor antennas at W6YBT comply with the new emission standards. Who knows what the proposed new charts may indicate?

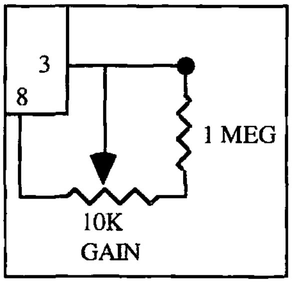
The hula hoop we built cost roughly $85.00; your costs may vary. I am indebted to W6WB and KN6TN for their assistance in calibrating the system.

Number 53 on your Feedback card

UPDATES

Digi-Sniffer correction

In the February 1997 issue on page 26 of "Build the Turbo Digi-Sniffer," the 10k resistor to the right of pin 8 should be fixed (not variable), with a wiper coming off of pin 3 like so:



Packet scene

In "Reviewing the Packet Scene," on page 40 of the May issue, author Roger J. Cooke's correct callsign should be G3LDI.

TOC

The May Table of Contents erroneously credits "Build the Bioelectrifier" (page 13), the reprint of last year's immensely popular article, to W6WTU. The correct author is, of course, WA8YKN.

No easy out

We received this note from Dave Miller NZ9E, moderator of our "Ham to Ham" column:

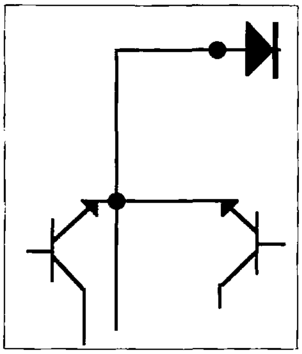
"Please note that the contribution in April 1997's 'Ham to Ham' titled 'Easy in & easy out,' having to do with home-brewing your own thumbscrews for easier installation and removal of a ham mobile transceiver, was credited to Mark Marholin KE6JJR, but was actually sent in by Phil Salas AD5X, 1517 Creekside Drive, Richardson TX 75081. I apologize for this error."

Pin Markings for the Multiplexer

In the May issue, in "Build an Audio Multiplexer," the U3 unmarked pin connected to U2 (pin 4) is #1. As for C8, the A+ side is positive. In the parts list, C5 should be 0.1 µF and C6 should be 33 pF.

TV/VCR Tuners Part 2 correction

In the May issue on page 37, Fig. 3 was missing a connection between two transistors. It should look like this:



Also, on page 38, Fig. 4 has a resistor off of pin 3 that is missing its value, 150Ω. Finally, the tuner pinout next to AGC in Fig. 1 should read VT, not YT. 73

NEVER SAY DIE

Continued from page 5

fix mine, and they're quite different. Hers are right in line with the green-world food list in Margaret's book, while mine are 95% in agreement with the red-world food list. Yes, I'll be eliminating that 5%, which could be causing me some minor chronic health problems.

The book is ISBN 0-964-3261-4-0, 142 pages, 1996, published by Veritas, Sedona AZ. Since it's not in many book stores your best bet is to get a copy from Margaret. Send $12 to Margaret Chaney, Box 726363, Berkley MI 48072. It could change your life. It will certainly change your perspective on life. How come all life is organized on male-female and red-green divisions?

The choice is up to you. You can keep on ignorantly doing what you've been doing to yourself, or you can read this book and give your body the break it has so desperately needed and has been trying to tell you about. It might even make you more fun to talk with on the air.

Flight 800

With the continuing mystery about the downing of 800, I would be shirking my duty to you as a known rag chewer if I didn't pass along a rumor I heard. It's a good solid rumor, considering the recent exposé TV shows substantiating the missile theory.

My understanding is that Flight 800 was delayed in departure and that at the time it crashed it was in the time slot of an El Al flight, leading to the probability that this could have been an Arab-inspired shooting down of the flight. Perhaps we have the Palestinians to thank? Or Syria, Libya, Iran or Iraq? Hmm, where was Arafat when the plane went down?

Well, you needed something better to talk about than the weather. Say, the weather has been changing, hasn't it? Maybe Ted Dames, the famed remote viewer who holds us semi-entranced on the Art Bell show, is right about the world coming to an end in two years. Drat, and that'll be before the sun spots really bloom for us again. Sigh, and I was so looking forward to being able to work 20m all night again.

Ear Plugs

Yes, Your Dishonor, I plead guilty to bashing the League. And to bashing our beloved federal government, both en masse and in each of its initialed and rightfully feared bureaus. And to bashing our music industry, our media, our legal (snicker) system, our health care (har-de-har) system, our educational (sigh) system, and so on.

Yes, I should open a cold beer, sit down and watch a ball game on TV, and stop reading subversive books. I should sink back into the hypnotized obedience shared by around 99% of the public and stop questioning authority.

Nothing can be done about the corruption which dominates our

Continued on page 70

Number 54 on your Feedback card

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119

Silk-screening a microwave antenna

The next antenna area to explore, and where I put most of my efforts, is in the construction of antennas for the frequencies of 1296 and above. In this region you can carry the antenna or antenna feed in your lunch sack—that is, with the exception of the microwave dish reflector. As you know, when the frequency is increased further and further, an antenna's size is reduced by the same proportions. The advantage is that GHz-type antennas are very small and can be built on top of a magazine cover.

The dish mechanism that the feed illuminates with RF is the device that provides the actual gain by focusing the RF radiated power into a beam, much like the reflector of a flashlight. The bulb by itself is bright, certainly, but then the reflector (dish) focuses the bulb's energy into a high intensity beam instead of scattering it in all directions. Very high gain in the 35-dB range can be achieved with relatively simple dish antenna sizes of three feet or so.

For instance, a dish, or more commonly, parabolic antenna, can be fed at many different frequencies. A large coffee can will function at 1296 MHz, while a smaller-diameter one will function at 2304 MHz. As frequency increases, so do the dimensions needed for a feed structure. Of course, as we go higher and higher, feeds get smaller and the need for more exacting measurements in the construction of these devices needs to be addressed. Using a coffee-can type of antenna feed is sometimes passed over in favor of newer designs, but the coffee can still will do a very good job.

You feed a coffee can by means of a probe connected to a type "N" coax connector spaced 1/4 wavelength from the rear of the can. This will be the transmitting probe. A second probe can be attached 90 degrees offset from the first probe and used for receiving. The coupling between probes so offset is minimum (with a typical coupling loss of 30 dB between them), providing very good isolation. This type of design was very popular in the early days of microwave, and in some cases is still used today. One name given to this type of feed is a Polaplexer, a sort of twist on the names polarization and duplexing or mixing signals together.

Today, much more efficient designs for the same frequency regions can be simply constructed by home fabrication techniques. The best of all worlds came together when I saw, for the first time, a triband feed constructed on a relatively inexpensive substrate glass epoxy FR-4 printed circuit board.

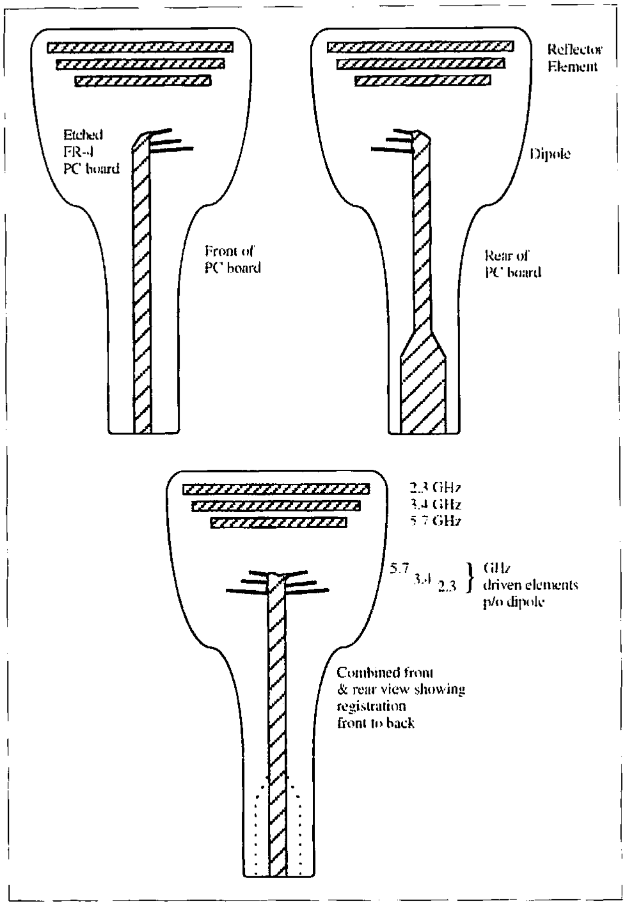


Fig. 2. Diagram of WA3RMX triband feed showing the rear and front sides of the PC board. Double-sided PC board is required, with an exact registration between both sides. Solder rear side wide trace to shell of RF connector, narrow trace to center pin. Scale artwork is available in The ARRL UHF/Microwave Projects Manual.

This three-band feed design with artwork for the PC board layout was published in both *The ARRL UHF/Microwave Projects Manual* and in the August 1990 issue of *QST*. I came across it while reviewing an article I authored with Kerry N6IZW in the same projects manual.

The antenna was designed by Tom Hill WA3RMX. Basically, this simple feed is quite clever in that a single piece of double-sided .062 copperclad circuit board (FR-4) contains a small, very efficient, low-power, three-band parabolic dish feed. The frequencies that this feed covers are the 2304 MHz, 3456 MHz and 5760 MHz amateur bands.

This feed had to be tried out by our microwave group to assist an ambitious project that called for the construction of a new microwave frequency band transceiver converter in time for testing at our monthly club meetings. Our intent was to construct as many different frequency converters as possible for communications on different amateur bands.

We had many rigs constructed on the 10-GHz amateur band, so we wanted to promote interest in the 1296 to 5760 MHz bands as well. I covered my 1296-MHz rig's construction in a recent past column and showed its versatile conversion scheme using the 1152-MHz local oscillator both for conversion and as a harmonic generator for markers at our higher frequency bands. The rigs constructed for 2304, 3456 and 5760 MHz had one common fault, and that was what to use for the antenna feed. This PC board design by Tom Hill could not have presented itself at a better time.

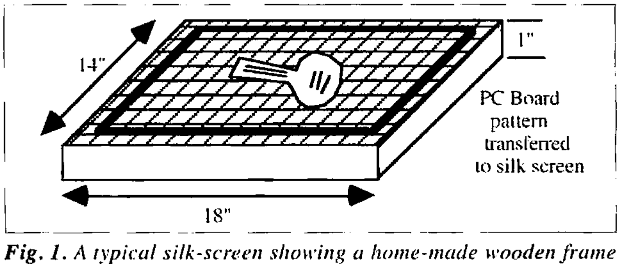


Fig. 1. A typical silk-screen showing a home-made wooden frame made from 1- by 2-inch pine. Black line is window screen tubing to hold fine-mesh silk-screen material in cut in bottom of wood. Make screen taut like a GI bunk. Screen material is actually nylon with 306 mesh threads per inch. The original process used silk, hence the name.

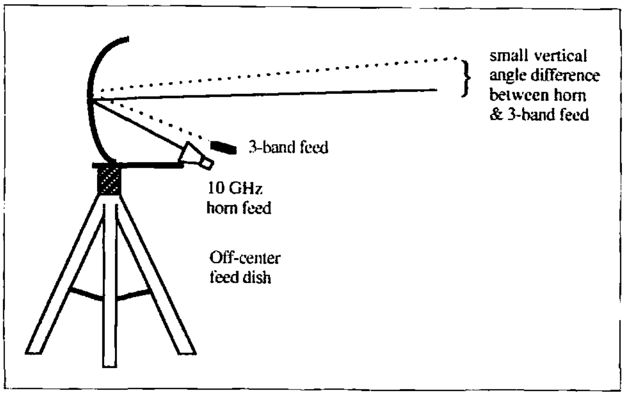


Fig. 3. Drawing of triband feed mounted on my off-center-feed dish with 10-GHz horn feed attached. The WA3RMX triband feed is held in place with a length of RG-141 semi-rigid solid copper jacket microwave coax. The RG-141 coax is bent and formed to position the 3-band feed just above the 10-GHz horn at the focus point. Slight vertical realignment is necessary to align either the horn or the tri-band feed. No repositioning is required in horizontal position.

The beauty of the PC board feed was that it could be employed on our standard dishes at the same time as our 10-GHz feed, and be positioned just above it—sort of out of the standard pattern. This arrangement allowed rapid frequency hopping with converters to operate on different bands. Once the dish antenna was properly pointed on one frequency, only minor changes in pointing angle needed to be addressed as we only had to change out the electronic packages (converters), keeping the dish on the same exact pointing angle to the distant station.

This made multiband operation very easy and quite enjoyable. We left all the 10-GHz equipment hot and connected, and just tilted the vertical angle to allow the 3-band feed (which was slightly higher than the 10-GHz one) to be properly aimed at the distant station. Because the 3-band feed was higher, we had to lower the front axis of the dish point angle for this feed, to lower than what was used for 10 GHz. It's just like watching a pool ball on a pool table bounce off the cushion. If the starting angle is higher than the first attempt, so will the course of the second ball be higher. It's the same with microwave dish antennas and pointing angles. See **Fig. 3** for a graphic depiction of this pointing angle difference between the 10-GHz feed and the three-band feed.

As mentioned, construction details for this feed were graciously provided in *The ARRL UHF/Microwave Projects Manual*. I wanted to use the silk-screen process because I was familiar with it and have material on hand to reproduce PC boards to near photo tolerances. I had tried the technique on a 10-GHz amplifier with success and wanted to see how my double-sided PC board construction skills would hold up, since most of my construction to date had been with single-sided PC board projects.

Silk-screening is relatively easy, but very fine lines stand the chance of losing detail since the mesh or screen has threads of .001-inch diameter. The artwork adheres to the screen just after its development in hydrogen peroxide, where it resembles a soft, Jello™-like substance on a Mylar™ backing. After development and washing in a stream of aerated, bubbling, mildly warm water, the pattern to be transferred to the screen is made clear while still in a somewhat jellyish liquefied state. It is this soft material that embeds itself into the screen, to make a tough surface once dried, allowing ink (resist) to be squiggled through the patterns of whatever you are making. The ink dries and the etching of remaining unprotected copper begins.

The finished process is the completed PC board. Of course, I forgot to tell you that you have to repeat the process on each side of the PC board to make a mirror image in the exact, or nearly exact, position (registration) from front to back. You will know you are okay if, when you hold the etched PC board up to the light, you see through the PC board and observe a symmetrical pattern (registration) between the front and rear sides.

The first step in making any artwork, be it for the photographic or silk-screen process, is to obtain a high-quality negative or positive of the original artwork to exact dimensions. The camera that I use is over 90 years old and weighs some 60 pounds. It's an antique but still functions well. The camera uses a slide plate film holder to which a sheet of film up to eight by 10 inches can be held in position, or a smaller piece of film can be taped in place. To focus this large-format camera, a frosted piece of glass in a holder is inserted in the back of the camera, and the lens opened.

You can see the object on the frosted glass and adjust magnification or reduction and focus manually. Final verification as to exact size is made by observing an IC socket, holding up a new IC, and comparing its pins to the film plane view. Using the IC like a micrometer for vernier, observe the exact placement of the first pin, and carefully check the last pin in a row for any error. This is a simple method for exact size requirements in your manual setup. For an object such as the three-band antenna, you have to rely on a vernier caliper to measure exact distances and allow a "fudge" factor for the silk-screen process.

I used a slight fudge factor, increasing dimensions about .003 to .005 inch to account for

processing with silk-screen reproduction of transferring etch resist inks to copper PC board. The screen material I used has about 300 threads to the inch (making them about .001 inch in diameter), so I doubled the thread dimensions as a fudge factor, giving some allowances for the fine antenna elements. I further doubled this screen factor to account for some undercutting of the PC board fine traces during board etching. See **Fig. 2** for an outline of the antenna pattern. For exact dimensions, get a copy of *The ARRL UHF/Microwave Projects Manual* and see the original artwork.

Why go through all this hassle to make a PC board using the silk-screen process? Well, there are several reasons, number one being that it is inexpensive and can be done at home easily. True, it does require some photographic capabilities, but that is true in any board process. The main reason is that once a screen is imprinted with a pattern of your current PC board project, you can squeegee inks onto a PC board (one side) as fast as you can count to five. Then, to make a pattern on a second side, you wait until the ink is dry, set up registration marks to verify that both sides of the board are in alignment, and screen off the second side. Both sides should be in alignment within 15 to 20 thousandths of an inch to function well.

I would not set up an individual amateur to do silk-screening to make one PC board. It is more suited for club projects where many boards are needed. To serve the club needs and be able to construct quite a few boards at one time for a current project is just one way to keep a group interested in new and interesting projects to aid their operation and goals.

Silk-screening is a great method for these club projects as it is very inexpensive. Materials for silk-screening can be stored for very long times and are not date-dependent. The film used to transfer an image onto a screen costs $25 for a lifetime supply, and can be used in normal indoor lighting. Just do not expose it to direct sunlight as it is very sensitive to UV light.

"It's just like watching a pool ball bounce off the cushion."

Normal exposure is sunlight contact printing for one minute. This film is developed in hydrogen peroxide and water (50¢ a pint in any drug or grocery store). The resist ink costs about $10 a quart and will last several years. The process is such that the transfer film is water soluble, while the inks are petroleum-based, requiring petroleum solvent (like paint thinner).

Now that I have gone through the entire process to construct a PC board antenna that can fit in my pocket, the project is just starting to get interesting. The next step was to test and determine how well we did. Will the antenna feed perform at all three frequencies or did we just spend a lot of time constructing something not usable? Well, whether you call us lucky or technically competent, I don't know—but testing showed a very usable antenna feed.

Kerry N6IZW was able to run a return loss test over the frequency span of 600 MHz to 6,000 MHz in one continuous swept test. See **Fig. 4** for the frequency sweep chart, showing very good results at our three frequencies of interest.

By the way, a good return loss measurement is just the same as saying a good SWR is present at a point of interest. Look at return loss as saying at a specific frequency the (device) is absorbing nearly all RF power and is returning very little RF power back to the source. While return loss is expressed as a dB value, SWR is expressed as a ratio between forward and reflected power.

dB return loss	SWR	% power reflected
40	1.02:1	0.01
30	1.07:1	0.12
20	1.20:1	1.00
15	1.45:1	3.00

Table 1. Return loss vs. SWR and reflected power.

The relationship between a low return loss dB value and a poor SWR is identical. See **Table 1** for a few relationships between the measurements.

The performance obtained from the triband feed was very good and showed a raw return loss of 23 dB at 2304 MHz, 30 dB at 3456 MHz, and 17 dB at 5760 MHz. The exact minimum return loss was in all cases a little high in frequency, although quite usable as is. While we missed the mark (high) by a small amount, this proved to be a very lucky break for us. The original antenna feed was tested "raw"—that is, without a protective coat of polyethylene or similar material to stop the copper from being affected by the wind, rain and such. When the finished antenna was sprayed with a protective coat of resin, the total effect was a dielectric loading of the elements and lowering of the resonant frequency a few percent, making all frequencies better placed on the slope of the return loss curve. Was this a case of three wrongs make a right? I'll never tell, but just call me lucky from now on.

In actual use suspended by the rigid RG-141 solid coax, my antenna proved to function very well. Changing to a different transverter band only required undoing the main DC power cable and the antenna coax as well as the IF coax, and connecting them back to the new frequency unit for minimum effort to change bands rapidly for any QSO party.

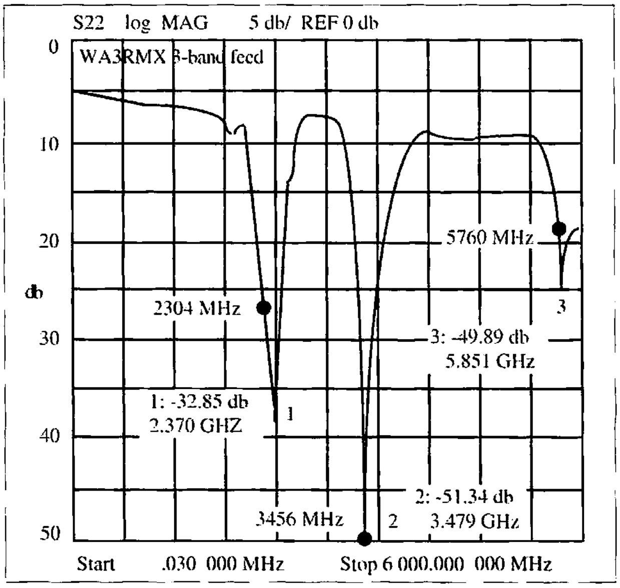


Fig. 4. Return loss curve obtained on silk-screened 3-band feed before dielectric loading.

Number 57 on your Feedback card

ON THE GO

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

High fashion for hams

What does the well-dressed amateur radio operator wear when called upon to provide communications in an emergency situation? While the handie-talkie on the belt and the callsign name tag are required, there are many other important accessories that should be on his or her list. The following suggestions are not intended to be all-inclusive, but should prove to be a good starting point for when you get that phone call to report to the disaster services office. Red Cross or other agency.

Radio gear

• The radio itself—don't laugh! It has happened. The old HT may come in handy as a spare, so pack it, too.

• Antennas—if you're taking a handie-talkie, you may want to include an extra rubber duck, a quarter or five-eighths wave telescoping antenna and a J-pole which can be rolled up, such as those made from 300 ohm twinlead. If you're taking a mobile rig, a magnetic mount antenna is essential, especially if you end up in a car not your own. Either a J-pole or a mag mount is extremely helpful if you end up inside a building. The J-pole can be thumbtacked to a wall or taped to a window. A mag mount can be set on top of a metal filing cabinet, which will provide an acceptable ground plane. Also, don't forget connector adapters. An antenna with a PL-259 won't work with a BNC-equipped radio without the adapter. If you have an extra length of cable with barrel connectors at both ends, you improve your chance of finding a good antenna location and a good operating position significantly.

• External microphone—you may have to set the radio away from easy access, so an external microphone is helpful. Also, if you are in the field, this allows you to keep the handie-talkie on your belt and position the microphone on your collar.

• Headphones or earplug—you may be surprised at the noise levels you may encounter, so an earplug is the least you should bring. Personally I like the dual headphones with a boom microphone. If the noise level is high, I use both earpieces. If it is quieter, I can slide one side off so I can hear nearby activity.

• Power—sure, you've got a battery pack and a charger, but how are you going to recharge it if there is no electrical power in the area? This is especially true if you'll be doing damage assessment and walking through the damaged area. Bring your NiCd batteries and charger, but also plan for the worst. A cigarette lighter adapter cable is always handy, as is a charger which can be used in a car. One of the least glamorous and most important accessories you can buy is a battery holder which accepts alkaline batteries. Most take AA, so make sure you have a ready supply of those, as well. If you're operating a high-frequency rig, make sure you bring along not only the power supply but also a heavy duty, and *very long* extension cord. AC power may be in one direction and your antenna lead in the other, especially if you are in a location which forces you to use a generator.

• Cases—some neoprene cases provide excellent shock protection. Some hams like to use a photographer's vest which has a lot of pockets and keeps everything handy.

Personal

While we often do pretty well with the radio gear, here is an area where we sometimes fall short. This is because we assume we'll be out for a day and be back home by night. Sometimes that just doesn't work out. Whatever time you estimate you'll be out, triple it when planning for these items.

• Medication—bring along any prescription medicines, as well as a small bottle of aspirin. If you are working a cold-weather situation, throat lozenges might be helpful. If you're going to be in the heat, don't forget the sunblock. And remember eyeglasses, contact lens supplies, etc.

• Clothing—not a suitcase full, but a few key items. Once again, examine the situation you'll be placed in. If you're at the disaster site, will you need to add a raincoat? Small ponchos are available for a few dollars which fold up into a package little larger than a handkerchief. Hats are essential for rain, cold and sunlight (especially if you're thin on top!).

"Whatever time you estimate you'll be out, triple it and plan for that."

Dress for the weather you are experiencing and throw in a few extras for the weather you might face later. A change of clothes can be essential, especially if they get wet. Shoes and socks are often the first to get soaked. Finally, remember your mother's advice and include some clean underwear.

• Toiletries—I like to carry a plastic bag with a disposable razor, sample-size shampoo, shaving cream and deodorant. I once spent four days at a hospital during a blizzard, and those were among the items I missed most.

Miscellaneous

• Identification—if you have been issued identification by a government agency, make sure you have it with you. Also, driver's license, hospitalization card and a credit card. Even though we are no longer required to have our ham license on our person, it is recommended that you carry that as well. Some agencies, such as the Red Cross, use window signs which identify a vehicle as being used by volunteer aid workers. This is useful because many victims of storms or other disasters are concerned about looters. An unmarked vehicle driving by slowly can be very upsetting to someone who has just been through a painful experience.

• Paper, pens, etc.—even if you are being sent to a shelter set up at a school, don't expect to find paper and pencils readily available. A small notebook is handy in the field, while a lined tablet on a clipboard works well in a fixed location. As they say, the smallest scrap of paper is greater than the greatest mind. I like to have a few ball points as well as a permanent felt-tip marker or two. The markers sometimes come in handy on duct tape for making signs, or marking equipment.

• Plastic bags—I like to carry half a dozen sandwich-sized zip-seal type bags tucked into a couple of the larger ones. They're great for keeping things dry, including notebook, spare batteries, etc. I'll also use the bags to hold some of my other supplies, so they do double duty.

• Flashlight—a small flashlight can be a lifesaver. You may not need it, but if you don't it isn't that heavy.

• The Little Stuff—electrical tape, small tool kit, and of course duct tape.

Naturally, each person will have slightly different needs, but this is a good starting point. Most of this should fit pretty easily into a canvas gym bag, and with the exception of the radio and power supply, you can keep such a bag packed and ready to go. I try to check my batteries, the pens, etc. twice a year—I check them when I change my smoke alarm batteries—the same days we switch to or from daylight savings time. This bag of supplies is kind of like a fire extinguisher: You may never need it, but it's nice to know it's available.

Don't forget to send your ideas and experiences, either to the address at the top of the column or via E-mail to [74640.1442@compuserve.com].

Number 58 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

New Russian in the sky

On March 4th at 0200 UTC a START-1 rocket was launched from the Svobodny cosmodrome in eastern Russia. The payload was a Zeya military satellite, with a few additions. The satellite weighs 87 kg, 14 kg of which is RS-16 (Radio Sport), the newest hamsat in the sky.

Although rumors of the imminent launch of RS-16 have been circulating for a number of months, information has been sketchy. With each bit of new data come more questions. When the new satellite achieved orbit, RS-16 went from conjecture and vaporware to hamsat status. Information began to surface on the Internet, but the pursuit of knowledge continues. What is a START-1 rocket? What and where is the Svobodny cosmodrome? What is a Zeya satellite? What is RS-16 good for? Who can use it, and how?

The rocket

The START-1 rocket is reported to be a modified SS-25 intercontinental ballistic missile (ICBM). In Russia, the SS-25 or "Sickle" is called the *Topol* (Russian for poplar tree). It was designed as a replacement for the unsuccessful mobile SS-16 ICBM. The SS-25 was developed by the Moscow Institute for Thermotechnology (MIT). Several tests were made in the early 1980s and the Strategic Rocket Forces (RVSN) of the Soviet Union accepted the SS-25 for official service in December 1988.

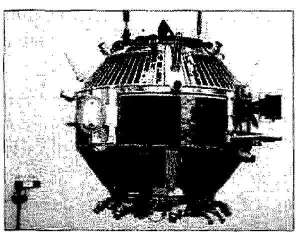


***Photo A**. The Zeya/RS-16 satellite rises from the ashes of the cold war.*

The Topol/SS-25 is a three-stage solid-fueled missile standing just over 60 feet without a warhead. It was designed to carry a single 550 kiloton nuclear warhead. Approximately 70 percent of all Topols for military service are deployed on large seven-axle mobile launchers. The rest are housed in silos.

In 1991 the USSR and the United States signed the START-1 agreement (Strategic Arms Reduction Talks) to reduce nuclear arsenals on both sides by 25 percent. Two years later after the breakup of the USSR, START-2 was signed. This document called for the elimination of almost 75 percent of the nuclear warheads and all the multiple-warhead, land-based missiles in the US and the former Soviet republics. Rather than destroy hundreds of SS-25 missiles, a program was begun to use them as launch vehicles for small satellites. Modifications included the addition of a fourth stage engine to carry the payload to orbit.

Svobodny

While the START-1 rocket has been flown before, the Svobodny cosmodrome is new. The launch of Zeya/RS-16 was the first from this new cosmodrome (128 deg. East, 51 deg. North) located in the Amur region about 100 km north of the Chinese border. Russia's primary heavy-launch space facility at Baikonur is in Kazakhstan. While the Russian Space Agency has a 20-year leasing agreement with Kazakhstan, it was considered prudent to select a site within the borders of Russia for an additional site. Svobodny was picked in late 1993 since it had various assets of the previous missile division in place which were transferred to the Space Test and Control Center.

Russia's other domestic space center is in Plesetsk. This site is farther north and is not equipped for heavy launch vehicles. The latitude difference is very important. A booster launched from Svobodny can carry 20-25 percent more payload weight to orbit than the same booster launched from Plesetsk.

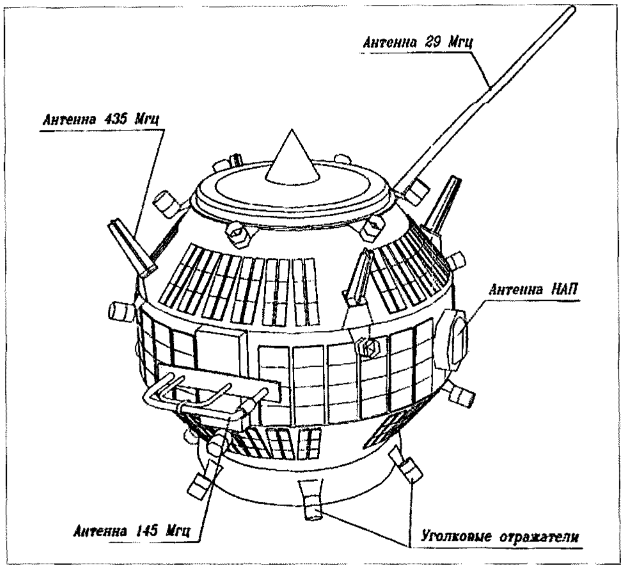


***Fig. 1**. Pictorial view of Zeya/RS-16 showing antenna locations (UA3CR & AMSAT-R).*

The Svobodny cosmodrome incorporates numerous facilities for launch and support operations. The launch sites include silos for Rokot and Start boosters in addition to large Angara vehicle pads that are currently under construction. Most of the complex is located on the north side of the city of Svobodny-18 except the helicopter landing area just south of the city near the Zeya River. Buildings for oxygen, nitrogen and hydrogen generation are part of the system, in addition to radio facilities, industrial operations, purification units and rocket fuel storage. A Rokot launch vehicle flight is scheduled for later this year. Support for the Angara launch vehicle will occur after the year 2000.

Zeya/RS-16

It has been reported that RS-16 is an integral part of the Zeya satellite. Previous RS spacecraft have been separate satellites or self-contained electronic units attached to another satellite deriving their power from the host spacecraft.

Zeya/RS-16 is primarily a navigation satellite with the addition of amateur radio devices. At 87 kg it is relatively small, but carries both a GPS (Global Positioning System) and GLONASS receiver system. On the outside of the craft, 20 laser reflectors provide a means for accurate ground-based optical tracking.

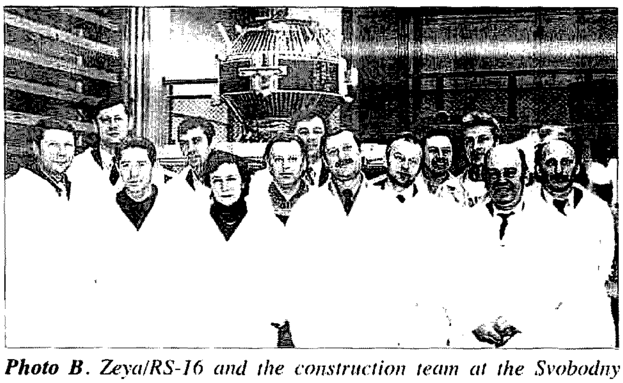


***Photo B**. Zeya/RS-16 and the construction team at the Svobodny cosmodrome. Project leader Alex Papkov RA3XBU is on the right in the front row (photo from AMSAT-R).*

Uplink Passband	145.915 – 145.948 MHz
Downlink Passband	29.415 – 29.448 MHz
10m Beacons	29.408 & 29.451 MHz
70cm Beacons	435.504 & 435.548 MHz

***Table 1**. Radio configuration of RS-16.*

The satellite's orbit is only 470 km up with an inclination of 97 degrees. This low polar orbit provides about four orbits per day for most hamsat chasers. The orbit is sun-synchronous with passes occurring around noon and midnight local time. These passes last between six and 14 minutes each, depending on the maximum elevation with respect to the observer.

Working RS-16

Our newest hamsat is a Mode "A" satellite with a few additions. Mode "A" refers to the combination of a 2m uplink receiver paired with a 10m downlink transmitter. The satellite is equipped with one 10m antenna, one or two antennas on 2m and four for 70cm. **Table 1** shows the uplink/downlink passband and beacon frequencies.

The 10m output power is switchable between 1.2 and 4.0 watts. The 70cm beacons run at 1.6 watts out. **Table 2** shows two typical samples of CW telemetry received on the 435.504 MHz CW beacon. The parameter definition column is incomplete due to a lack of information from the satellite builders. More details will filter out of Russia in the months to come.

Shortly after launch, the 10m beacon on 29.408 MHz was active, sending data back to ground controllers in Russia and monitoring stations around the world. This beacon was then shut off, while the 435.504 MHz beacon was activated. The beacon frequencies on 10m and 70cm are easy to receive. The signals are quite strong. A portable shortwave receiver with SSB (single-sideband) or CW capability can receive RS-16 with only a built-in whip antenna. The 70cm beacon is strong enough to open the squelch on a FM handie-talkie with only a "duck" antenna on a good pass. To get good copy on the 70cm CW telemetry, though, a receive converter or multimode 70cm rig is needed. There was some early speculation about the possibility of a transponder output between the two 70cm beacons, but sources in Russia have stated that the craft does not have that capability.

When the transponder is activated for general use, operation should be as easy as the popular RS-10 satellite, only with better downlink signals. RS-16 promises to be an exciting satellite. It's in orbit and it works. Old ICBMs are good for something... more hamsats!

Field Day 1997

Field Day is always scheduled for the fourth weekend in June. This year that occurs on the 28th and 29th. We have one fewer high altitude satellite (A-O-13), but a few new low-earth-orbit satellites for extra points in the American Radio Relay League competition, or for the AMSAT (Radio Amateur Satellite Corporation) activity. The AMSAT rules last year worked well and will show little if any change for 1997. Check the AMSAT Web page at the URL (Universal Resource Locator) [http://www. amsat.org] for details. The Field Day information is down a few levels under the "activities/amsatfd" subdirectories. The rules will also be published in the *AMSAT Journal*, or can be obtained for a self-addressed stamped envelope from me, W5ACM.

CW Data Day Pass	CW Data Night Pass	Parameter Definition
RS16	RS16	Satellite Identification
P167	P158	PSU Voltage (16V nominal)
O220	O0	Solar Panel Voltage
N46	N0	Solar Panel Current
M0	M0	
L0	L0	
K7	K7	
J5	J5	
I7	I7	
H49	H49	
G0	G0	
F164	F155	
E8	E9	Inside Temp. 1 in degrees C
D5	D5	Inside Temp. 2 in degrees C
C8	C9	Inside Temp. 3 in degrees C
B8	B9	Inside Temp. 4 in degrees C
A6	A6	Inside Temp. 5 in degrees C
RS16	RS16	Satellite Identification

***Table 2**. Partial description of 70cm telemetry values received from RS-16 on March 23, 1997, for two typical day and night passes.*

Number 60 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Color quagmire

I've been re-reading some of my old color TV reference books, and I feel I was not sufficiently accurate in last month's treatise regarding the encoding of the color signal. Although the chroma portion of the signal is, indeed, encoded on the color subcarrier, I'm afraid my description of exactly how it's done was a bit off the deep end in spots. To fully understand it, you need to delve into quadrature modulation, I and Q signals, and some other pretty hairy stuff. For our purposes, though, just consider that the color subcarrier is a complex signal whose positive and negative peaks contain separate color information, and whose phase describes the color value, while the amplitudes of the peaks describe the saturation (strength) of the color. And oh, yes, it's a suppressed-carrier signal, just like we use on sideband radios.

Touchy

The upshot is that the color subcarrier is one touchy signal, especially where time is concerned. Just a few fractions of a microsecond of time jitter, and it's useless. In normal broadcast service, this sensitivity to timing errors wasn't important, as the timing of a signal doesn't change just because you send it over the air. At least, not with line-of-sight VHF/UHF signals.

Recording it was another matter altogether. No mechanical system can remain stable enough to avoid sub-microsecond timing errors! In fact, typical errors for a moving device are many orders of magnitude greater. But before we get into the fine details of recording color, let's look at video recording in general: how it happened, what it took to make it work, and what led to the development of that $250 VCR on your shelf.

A lotta lotta

By the time all-electronic television was developed, audio recording had been around for a long time. Starting with the good ol' needle-in-a-groove approach of the phonograph record, and progressing to practical magnetic recording, there'd been lots of development in sound recording. Sound wasn't really that hard to record. All you needed was a fairly stably-moving medium and a way to impress a varying signal on it. The key to the relative ease of recording sound was that the amount of information required was not high. For decent, understandable speech, 3 kHz would do. For good music fidelity, no more than about 20 kHz would ever be required, since most human ears can't hear anything above that anyway. Of course, to provide the true high fidelity of today's sound media, many years of research were needed, as frequency response is only a small part of the overall requirements. And research into better sound is still going on at a furious pace. Still, if you could capture 3 kHz or so on any medium, you could record usable sound.

The requirements for storing television signals were much, much greater. In TV, there's a whole lotta signal going on! A monochrome signal conforming to the American format of 525 lines and 30 frames per second required well over 3 MHz, or 1,000 times the bandwidth of a low-fi speech signal. Even long before color was part of the equation, people were searching for ways to record TV signals. The broadcast industry badly needed a way to store programs for editing and later transmission.

The first successful approach to storing television images didn't record the video signal at all! Called the "kinescope," this machine simply put the image from a picture tube right onto regular movie film. It worked decently, but because the scanning lines of the original picture, as captured on film, didn't precisely match up with the scanning lines of the camera later used to transmit the image from the film, moiré patterns were a real problem. Also, the film had to be developed before the image could be used. Nonetheless, broadcasters made wide use of the kinescope, simply because there wasn't anything else available. Many great programs, such as the early *Honeymooners* and *I Love Lucy* shows, survive today only because of the old kinescope recordings.

The hunt was on for a better way to preserve and manipulate television images.

> **"I sure wouldn't have wanted my fingers anywhere near those reels when they got up to speed!"**

Crank 'er up

Well, if you needed more bandwidth, you just increased the tape speed of a normal tape recorder until you could cram it all on tape, right? Believe it or not, people built such machines, with linear tape speeds of hundreds of inches per second. These things had huge reels of tape, and I sure wouldn't have wanted my fingers anywhere near those reels when they got up to speed! Did they work? Well, kind of, but it wasn't as simple as just running the tape fast, though. No magnetic head can be designed to have a frequency response from near DC to many MHz, because tape heads are inductors (after all, they're just coils of wire wrapped around a dough-nut-shaped core with a gap in it), and inductors resonate. Also, if you make the gap small enough to capture the high frequencies without their blurring together, the head will have almost no low-frequency capability. Still, semi-successful machines were built by splitting the video signal into several bands of frequencies and recording them in parallel on one tape, with head gaps optimized for each band. The BBC actually used such a machine on the air.

A geared-up analog tape recorder had tremendous limitations, though. The obvious one, of course, was how much tape it took to record a useful amount of programming. Even more serious limitations, though, revolved around technical issues. For instance, the splitting and recombining of the video signal resulted in all kinds of phase shift problems, especially since the slightly irregular motion of the tape over the heads caused timing errors that varied from track to track. The result was a wobbly, distorted picture, but it was a video signal, and it was a start toward a practical video recorder.

My head is spinning

In 1956, after several years of research and development, Ampex Corporation introduced the first rotating-head video recorder. Called the "quadruplex" VTR, because there were four heads mounted on the rotating wheel, this machine was aimed at the broadcast market, and was designed to its requirements of high precision. For instance, the mechanical timing error could be servo-adjusted to about one microsecond, which was necessary for proper editing. This was no ordinary tape recorder! Employing two-inch high-precision tape, it involved some revolutionary techniques, such as the servo-controlled rotating heads and FM recording, and cost around $100,000! The heads, which only lasted a couple of hundred hours, cost thousands of dollars to replace. And, on top of everything, a well-trained technician was required to operate and maintain the monster. It was a tremendous success, though, and quad VTRs were the broadcast standard until about ten or fifteen years ago. I'd venture a guess that some are still in use, though they've largely been replaced by much cheaper, more modern formats.

Although the quad VTR did not filter down to the home user, its basic principles were adapted for later, simpler machines that didn't require broadcast precision. The most important innovation was

the rotating head concept. There was just no getting around the fact that a high head-to-tape speed was required for the bandwidth of a TV signal. But why move the tape past the heads real fast when you can move the heads themselves? By using a narrow track width, and spinning the heads, it was possible to create a series of tracks next to each other on the tape, effectively utilizing the entire surface area of the medium in a very efficient manner. This permitted the linear tape speed through the machine to be slow (the quads ran at 15 inches per second, and a modern home VCR runs at a fraction of an inch per second). At the same time, the actual head-to-tape speed could be anywhere from, say, 300 to 1,500 ips. Though the rotating head technique introduced all kinds of technical obstacles of its own, it at least solved the bandwidth problem, which had plagued the development of video recording from the very beginning.

In 1960, only four years after the debut of the quadruplex VTR, Sony Corporation introduced the first commercially available helical recorder, which also had rotating heads, but which differed in many significant respects, and cost about 1/50 what a quad machine cost. Although there's much controversy over who actually invented the helical concept, in which the tape is wrapped around a drum in diagonal fashion, producing a slanted recording track, it appears that it, too, came from Ampex. Sony and Toshiba quickly developed it into a viable product, though, while Ampex stayed devoted to making the big broadcast machines.

This new, relatively inexpensive, machine was aimed at the non-broadcast user, and wasn't designed for the tight specs required for broadcasting. It, too, was an instant hit, and refinement of its principles, and conquering of the color problem, eventually led to the modern VCR. Next time, we'll take a look at helical video recording. Until then, 73 de KB1UM.

LETTERS

Continued from page 7

Amateur Radio art on the HF bands whereas additional theory is not. It is a skill that can be mastered by anyone... who is not mentally handicapped..."

The CW requirement was a logical necessity in the eras when it was the only or primary means of radio communication. With CW's actual usage today accounting for only a small fraction of contacts and being arguably the least efficient mode of data throughput, it has been retained as a form of hazing with absolutely no logical supportable argument as to why its retention upholds any of the five principles our service is charged with in Section 97.1 of the FCC rules. In fact, today CW's requirement is in direct conflict with all five of these principles. I will assume Mr. Hanlon slept through his Novice theory class and missed these fundamental reasons for our existence.

These principles include "to advance the radio art, to improve communication and technical skills and to increase the number of trained radio operators and electronic experts." The wrong answers on the Novice test include "to preserve old radio techniques" which unquestionably describes the requirement of CW. There is no mention that testing should be used to preserve the status quo with regard to the numbers using the HF bands, as he suggests, but rather we are charged to increase the number of trained operators and electronic experts. Creating and maintaining community and emergency service relationships (another one of our principles) are much more easily obtained when one first demonstrates modern, fast communications in a form everyone can understand. And if "untrained" people can communicate effectively internationally with the Internet, there is no reason similar goodwill cannot be enhanced (principle #5) with the many other forms of communications at our disposal, rather than hobbling our efforts by filtering out bright potential representatives.

Continued on page 77

QRP

Number 62 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

With Field Day just a few weeks away, I thought this month I would take a look at the different ways we can power our QRP rigs in the field. Perhaps the simple fact that a fully operational HF ham station can be operated from a small NiCd pack is the biggest plus for QRP operation. Of course, not only can we operate our equipment with such small energy sources, but we can make worldwide contacts at the same time.

I've always been a sucker for battery powered stuff. I've got one of the few battery-powered lawn mowers in the county. As a matter of fact, it's the only solar-powered lawn mower I know of in the *state*.

Batteries for portable QRPing

My first fully functional portable QRP station consisted of a Heath HW-8 and a small six-amp-hour lead-acid motorcycle battery coupled to a small homemade solar panel: I could run this station for a week before the battery went south.

Of course, the motorcycle battery was not designed for cycle use (sorry!) and was quickly destroyed. Today, we have a whole slew of energy choices to pick from. Many of us are well aware of rechargeable batteries. We use them all the time in a wide assortment of gadgets. But don't overlook the use of secondary (non-rechargeable) batteries for QRP use. We'll look at those guys some other time.

When we start talking about batteries, we need to know two important design specifications; energy density and energy stored per unit of weight.

Energy density is, in its simplest, how much energy can be stored in a certain amount of space. Different battery chemistries have different energy densities. The idea is to select a battery that has the largest energy density. While this sounds simple, it's really not! Some of the newer hi-tech batteries are so expensive, you can't afford to use them. Others have strange charging demands and require special devices to recharge them.

Energy per weight is also a simple way of stating how much bang can be placed in a certain weight. There's a specialized name for this, but what matters to us is how heavy the battery must be to operate a given load for such and such a time.

There's not enough room to go into all the diversified types of batteries we could use to power our rigs during Field Day. Instead, I'll look at two of the all-time favorites as well as two new types just now coming into the market.

"My first QRP rig ran on a motorcycle battery and homemade solar panel. It could go for a week."

Lead-acid batteries

These guys have been around for eons. They're simple, easy to build and totally recyclable. In a nutshell, the lead-acid battery consists of two slightly different types of lead or lead paste suspended in a weak sulfuric acid solution. Passing an electrical current between the two plates changes their chemistry, while increasing the specific gravity of the acid. Connecting a load between the two plates reverses the process. You can repeat this charging and discharging cycle thousands of times, provided you don't abuse the battery.

On the down side, lead is lead and it's heavy. Then, of course, you have all the acid to contend with. The lead-acid battery does not like cold temperatures and in fact, if the battery is discharged, it will freeze if allowed to get too cold.

Lead-acid batteries also produce hydrogen gas when charging, so you can't use a lead-acid battery in a sealed container.

Some of the problems with the liquid acid electrolyte have been fixed by suspending the acid in a gel. The result is the gelled lead-acid battery, or "gel cell." With the acid thus suspended, you can easily operate the battery at any angle, including upside down. Within reason, you can subject a gelled lead-acid to freezing temperatures without damage. That's one of the reasons for the large 1000-amp-hour-plus gelled lead-acid batteries. You'll find these guys hiding in telecom sites worldwide.

Charging a lead-acid battery

You can use either a constant current or constant voltage charging scheme. A simple 78-series regulator configured as a constant current source is super cheap. Just set the current to whatever the battery is designed to accept. If you choose to use a constant voltage charging source, a lead-acid battery will need to be charged to about 14.1 to 14.5 volts. The final voltage will be set by the battery manufacturer. Always follow their specifications. Some of the newer captive gel lead-acid batteries will be destroyed if the terminal voltage during recharging exceeds 14.1 volts.

You can also use a specialized IC to charge your lead-acid batteries. Several companies such as Maxim and Linear Technologies produce lead-acid battery charger ICs. And of course, I had the popular pulse charger presented here years ago that works super on the gelled lead-acid batteries.

For me, nothing beats running a QRP rig from a lead-acid battery. They're cheap and easy to come by. When they die, they are accepted by anyone who sells lead-acid batteries, including all the major car repair outlets.

With capacity choice ranging from 1 amp hour to 1900 amp hours, I find the 6.5-amp-hour battery to be just about perfect. It has more than enough oomph to run a five-watt rig all day long—and it can easily be recharged with a small 10-watt solar module. The 6.5-amp-hour battery is light enough to tuck into your backpack for those trips that really do go into the field.

NiCds

I guess this battery is the number one rechargeable used in the consumer market. It's no wonder—we've seen the trickle-down effect of all those cordless phones and power tools.

NiCd batteries consist of a mix of nickel and cadmium held apart by a base electrolyte instead of the acid base, such as sulfuric acid, used in the lead-acid batteries. The electrolyte used in a NiCd is usually potassium chloride.

The cadmium inside a NiCd is *extremely* toxic. Depleted NiCds *must* be disposed of correctly. In fact, so many NiCds are living in so many consumer goodies, you can take your deal packs to any local Radio Shack store for disposal. Many other electronic stores are also supporting a battery disposal program, too.

NiCds come in a wide variety of shapes and sizes. Most of us are used to seeing the AAA, AA, C, and D cells. Current capacity ranges from milliamperes to amperes within these sizes. You can also choose the sub C cells and the so-called sub D cells, too. After you reach the D cell, usually the next step is what is known as wet pocket NiCds. For our use, we won't discuss these today. I *can* tell you they are very expensive.

At 1.2 volts nominal, the NiCd will produce a lightly lower terminal voltage when compared to a same number of lead-acid cells. The nominal voltage for a lead-acid cell is 2.0 volts.

Memory effect, or what happened to my charge?

Depending on whose back yard you're talking in, NiCds have a memory or they don't. In case you've been stranded on a island, NiCd memory is simple to understand. Here's how it goes: You charge up the batteries, say, in a cordless phone, and use the phone for one hour each day. Every time you are done with the phone, you plop it back into its handy charger. After a while, the phone will only work about one hour. In effect, the battery has developed a "memory" of being used only one hour and that's all the juice it will give up. Buy a new cordless anything and you'll see in the instructions all about battery memory.

On the other side of the fence sits the guy making the batteries. They say the problem is not with the battery, but how the battery is charged. Improper charging produces the memory effect.

Brainwashing, or dealing with NiCd memory

The best way to eliminate NiCd memory is to simply use the batteries to their fullest before recharging. Allow your cordless phone to beep the low battery warning before returning it to its charger. Some companies have designed special battery cycle circuits that discharge the battery first and then recharge them at a controlled rate. At first, it sounds like a good idea, and it does work. However, it also cycles the battery every time you place it into the cradle of the machine. In effect, to fight the memory, you shorten up the life of the battery pack. So, save your money and just recharge the NiCds when they no longer can run the load.

There's a slew of specialized charge control chips on the market to help prevent memory problems with NiCds. In fact, BAH has some software that will configure their chips to handle just about any type of cell or cell configuration. The next time you are surfing the 'net, check out this site: BAH.

Fast-charging NiCds

Fast-charging NiCds seem to be the "in" thing today. By using one of the controller ICs, it's not that hard to do. However, if you plan on building a NiCd pack and installing it in your new rig, and want to fast charge that pack, think first! Fast charging will cause the battery pack to really get hot. So hot, in fact, that you must add a thermal cutoff to one of the cells. That way if the cell overheats, the cutoff will tell the controller IC to stop or reduce the charging current. Now, I don't know about you, but I would think twice about putting something that hot inside a box holding a VFO of mine!

Building a stick

Since most of the NiCds I've come across are in the standard sizes such as C or D cells, it's easier to build a NiCd stick. I prefer to use sub C cells with metal tabs spot welded to the ends. It's not good to solder directly to a NiCd cell. Buy the tabbed cells instead. The tabs usually need to be trimmed a bit shorter before soldering together.

You'll need some heat-shrink tubing, large enough to slip over the cells. Solder the tabs together on five cells, leaving a plus and negative lead. Join the cells together with a wrap or two of nylon strapping tape. Slide the heat-shrink over the assembly, and, using a heat gun, shrink the tubing. Make a second stick. I generally use a fuse between the two sticks. A small inline fuse holder is ideal.

If you plan on using a fast charger, don't forget to add the necessary thermal cutoff to one of the cells. Usually, I make up two five-cell sticks. There's no reason you can't tape the two sticks together to form one NiCd battery. With the two sticks done, it will give you a nominal 12-volt battery at about three amp-hours, using 3,000 mA sub C cells. If you don't want to mess with all the work, I've seen ready-made NiCd sticks on the surplus market.

Zap those NiCds

When looking for batteries on the surplus market, you sometimes find bargains that seem too good to be true. Most are. Older NiCd cells sometimes develop internal shorts. These are caused by small whiskers shorting out the internal workings of the cell. One way to get rid of these whiskers is to zap them with a high current jolt. This vaporizes the whisker, allowing the battery to be charged. Or so they say.

"I have the only solar-powered lawn mower I know of in Ohio."

I've used a large capacitor, a zillion mF or so, and then discharged the cap across the NiCd. That burst of energy will zap just about any whisker hiding inside a cell. On the down side, most zapping will only give you a few more cycles before the whiskers grow back and the process has to be repeated. Zapping NiCds works best at the cell level. Zapping a complete battery, with many cells inside, usually won't work. And to make matters worse, most of the battery packs are sealed and you can't get to the individual cells. My opinion? Zapping NiCds is a waste of time.

Tidbits

No matter if you use lead-acid or NiCd rechargeable cells, there is a time when the cells will no longer work. Remember, rechargeable means rechargeable, not eternal.

Always keep in the back of your head the amount of energy stored inside a battery. Just a single sub C NiCd has enough capacity to weld tool tips and melt metal. A fuse is always required with any battery pack.

Also, keep in mind the very nature of batteries. They all have rather nasty guts inside. Always dispose of them correctly. And never *ever* throw dead batteries in a fire. They'll explode!

Ham Radio Fun

Communications Simplified, Part 18

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

Connectors and splices

Fiber cables can be connected together in various ways, but the connection must be done carefully to avoid light loss from one cable to the next. Splices and fiber optic connectors have to do two things: hold the two fibers firmly together end to end, and align the two cables so as much light as possible goes from one into the other.

Connections can be broken down into three types:

- Pluggable connectors
- Splices where the two fibers remain separate
- Splices where the two fibers are joined into one

There are a number of factors that come into play:

Distance between fibers. If the two fibers are separated from each other, light will escape the joint. Thus those splices where the two fibers actually join into one are best. But when the fibers remain separate, it is usually best that they do not touch, because actual physical contact between them can cause scratches which deflect or even reflect the light. Holding the two fibers firmly, keeping them aligned, yet not letting them touch obviously requires care. In some connectors, a liquid with a similar index of refraction is placed into the gap between the two fibers to provide a better light match.

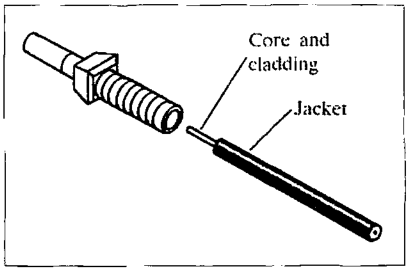


Fig. 1. One type of plug for plastic fiber.

Side-to-side alignment. The two fibers must be aligned side-to-side to within a small fraction of the core diameter. For example, with a 5-µm core diameter, a side-to-side alignment error of more than one µm would be critical; with a 980-µm core, one µm would be irrelevant.

Core and cladding diameter. Clearly, connecting two identical cables is best. Their diameters can be different, however, as long as the smaller fiber feeds the larger one. In this case, the light from the smaller fiber enters only the middle of the larger one, but none is lost. If, on the other hand, a larger fiber feeds a smaller one, then some of the light coming out of the larger fiber "spills" outside the core of the second fiber, and light is lost.

Numerical aperture. Again, connecting two identical cables is best, because the cones of acceptance then match. If the NA is different, however, then it is best that the fiber with the smaller NA feed the one with the larger NA; in this case, the light coming out of the first fiber comes out in a narrow cone, which fits into the wider cone of the second fiber. If the opposite is true—the larger NA feeds the smaller NA fiber—then some of the light coming out of the first fiber again "spills" outside the cone of acceptance of the second fiber, and light is lost.

Pluggable connectors

Pluggable connectors come in many types; **Fig. 1** shows one kind of connector for plastic cable. Once the outer jacket is stripped from the inner core and cladding for about 1/4 inch, the fiber is slipped into the connector. Metal teeth inside the connector keep the jacket from pulling back out. The connector's manufacturer provides a metal tool which slips over the narrow end of the connector, and guides a hot knife which is used to cut the excess fiber so it protrudes just slightly from the end. The flat side of the knife is then used to melt the end of the fiber flush with the end of the connector.

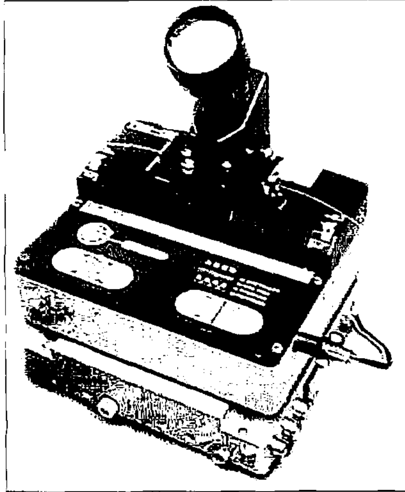


Fig. 2. A semi-automatic fusion splicer.

From this description, you can imagine that this is not a very accurate or delicate process. In general, plastic cables have so much loss that most cables are short; a few dB more or less is then not considered significant, and there is no need for super precision.

The situation is quite different with glass fibers, where it is usually more important to minimize losses. Whereas plastic fibers are just cut with a hot knife, glass fibers are carefully cleaved. That is, a narrow groove is scored into

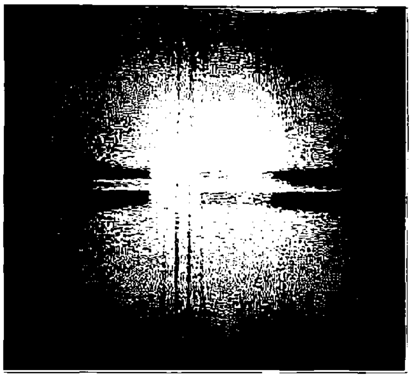


Fig. 3. Microscope display on semi-automatic splicer.

the glass, and then the glass is bent slightly until it snaps. The end of the fiber is then carefully polished, rather than just being melted with a hot knife. Sometimes, the end is polished flat; other times it has a slight convex curve.

Splices where the two fibers remain separate

Splicing two fibers so that they remain separate (as opposed to being fused together) is also done in various ways. For example, a plastic splice very similar to **Fig. 1** is available from the same manufacturer. It looks like a double-ended connector, with one fiber being slipped in from each end. As before, metal teeth hold the outer jacket to prevent the fiber from slipping back out. Since the connector itself is black plastic, it is impossible to see how close the two fibers are to each other. Fortunately, the multimode fibers are thick enough to tolerate slight misalignments.

Glass fibers, and especially single-mode fibers, require much more careful alignment. These splices are usually done with the aid of a special metal or plastic block. A small groove cut into the block holds the two fibers; once you position the two fibers in place, a cover is attached to the top to squeeze and hold the two fibers in place.

Glass fibers can also be mechanically spliced by being held together in a small tube and glued with an optical glue.

Splices where the two fibers join together

Glass fibers are most often spliced with a *fusion splice*. Here the two fibers are carefully aligned together, and then an electric arc melts their ends and fuses them together into one. Finally, heat-shrinkable tubing is slipped over the splice to hold the fibers and make the assembly rigid.

In the early days of fibers, this was a purely manual operation done by carefully trained technicians. Splicing today, however, is so frequent that there are several commercial fusion splicers on the market which make the job almost trivial.

Fig. 2 shows one such unit made by Fujikura. This splicer projects an image of the fiber onto a small microscope screen; the technician uses the controls to carefully align the fibers to get them into position, and then pushes a button to start the fusing process. **Fig. 3** shows the display during the splicing process. This particular unit is fairly small and popular with users who have to make splices in uncomfortable surroundings, such as on top of a telephone pole.

Fig. 4 shows another fusion splicer. This one is somewhat larger and heavier, but it is fully automated. Once you cut and strip the fiber, you simply insert it into the machine, and it automatically aligns and fuses the fibers. Instead of a microscope screen, this unit has a built-in TV camera which shows the process on a small LCD display screen, complete with messages at the bottom to indicate progress. It can also display the image on an external TV monitor; **Fig. 5** shows that image during splicing.

A well-done fusion splice can have as little as 0.2 dB loss; any fusion splice with a loss of 1 dB or more will generally be redone. A good non-fusion splice, on the other hand, seldom approaches even the 1-dB level.

Light sources

The light source for a fiber optic system can be either a light-emitting diode (LED) or a semiconductor laser.

LEDs are perfectly adequate for short cables. They are much cheaper, simpler to use, and also last longer.

Semiconductor laser diodes, however, have a number of advantages that outweigh their higher cost and complexity. Not only are laser diodes faster and brighter, but their main advantage, especially for longer runs of fiber, is that their light output is much more pure.

We have earlier discussed the problem of dispersion, and how dispersion limits the bandwidth of a fiber. What we did not say at that time was that the speed of light through a fiber depends slightly on the color of the light—that is, on its wavelength. The light from an LED, although it looks like a pure color (and is, in fact, much purer than the light from a colored light bulb), actually still consists of a range of wavelengths. The various wavelengths in a pulse of LED light will therefore arrive at the far end at different times, causing dispersion of the pulse. A laser, on the other hand, generates a very pure light with a very narrow range of wavelengths. Its light is therefore dispersed much less.

This is not important for lower bandwidths or short lines, but it is critical for very long lines. Hence single-mode glass fibers, which are used for long distances, are almost always used with laser sources, and many multi-mode lines are also.

Semiconductor diode lasers, however, do not last as long and are more fragile. Whereas an LED will output light over a fairly high range of currents, the current into a laser diode must be much more carefully controlled. Too little current, and the laser behaves more like an LED—too little light, and not sufficiently pure. Too much current, and the laser burns out. The laser diode also heats up much more than an LED, and its current requirements depend on its temperature. Hence diode laser assemblies often contain a second diode, which is mounted near the laser and detects its light. This diode detector is used in a feedback circuit to control the amount of current fed to the laser diode, which complicates the drive circuitry.

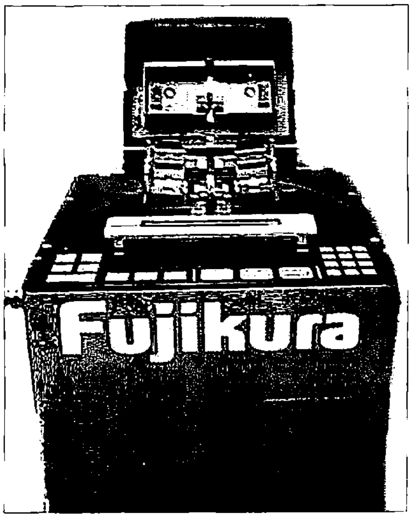


Fig. 4. Fully automatic splicer.

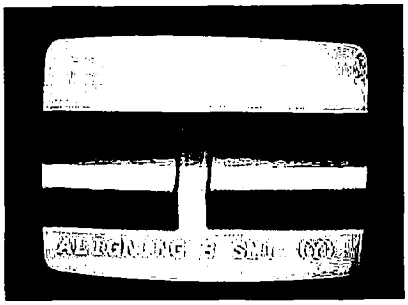


Fig. 5. TV display from the automatic splicer.

Fig. 6 shows two laser diodes, which differ only in their mechanical details. The smaller diode on the left needs a separate diode housing which would properly align and attach the laser to the fiber. The larger unit on the right comes with a short length of optical fiber called a *pigtail*. It is already aligned and attached to the diode body by the manufacturer to provide maximum light transfer; you would simply splice the end of the pigtail to the rest of your fiber.

The connection between a laser and the fiber is inherently lossy. For example, the lasers in **Fig. 6**, both made by M/A-COM, are identical GaAlAs diodes (made of gallium, aluminum, and arsenic) which typically output 7 milliwatts of light power at approximately 830 nm in the infrared range. The pigtail is an all-glass 50/125 graded index cable with a numerical aperture of 0.2, whose output is typically only 2 mW. Thus there is over 5 dB loss in the connection.

Before we leave laser diode sources, it is a good idea to just mention safety. Although power levels of 2 or 7 milliwatts seem trivial, they can nevertheless be extremely dangerous because the beam is concentrated into a very small area. If it strikes your hand, you will not even feel it. But if it should enter your eye and be focused by the lens in your eye onto the back of your eye, it can burn the retina and/or optic nerve and cause permanent blindness. Infrared lasers are especially dangerous because you cannot see their beam and may not even be aware that it is on. The standard warning on many laser devices is this: "Do not stare directly into the device or view an operating laser at close range. If viewing is required, the beam should only be observed by reflection from a matte surface utilizing an image converter or by use of a suitable fluorescent screen."

Radio Shack™ sells an inexpensive fluorescent screen that can be used to detect infrared light. CCD image sensors of the type used in camcorders are also sensitive to infrared, and can be used to view where a beam is going. But don't shine the laser beam directly into the camcorder lens, or you will burn the CCD sensor. In fact, when optical fibers are used in short lengths, attenuators in the form of dark filters have to be added to the line to prevent the detector from being damaged.

Light detectors

At the far end of the fiber, a detector is used to sense the light and convert it back into an electrical signal.

The simplest detector is simply a diode. When a diode is reverse-biased, only a small amount of leakage current flows through it, but when it is exposed to light, the leakage current increases. This increase in current can then be amplified. An ordinary diode, though, is much too inefficient, especially at the low light levels coming out of a fiber. The light sensitivity can be increased by modifying the diode.

One common photodiode used is the *pin* diode. As the name indicates, the diode consists of three layers—a P layer, an Intrinsic semiconductor layer, and an N layer. By properly doping the layers, the sensitivity can be significantly increased. An even more sensitive diode is the *avalanche* diode, which relies on the avalanche effect to internally amplify its response to light.

It is also possible to use a photo-transistor; this is simply a small transistor in a transparent case. Normally, a transistor requires a base current to conduct; otherwise there is just a small amount of leakage current in the collector circuit. But exposure to light produces charges in the base, which then lets the transistor conduct just as though there had been a base current. Phototransistors are quite sensitive, but not fast enough for high bandwidth use.

Physically, detectors are packaged in much the same ways as the LEDs and laser diodes intended for fiber optics, both with and without pigtails. Some detectors also come with built-in integrated circuit amplifiers which simplify the external circuitry.

Conclusion

There are a few points we have omitted in our discussion so far. One is this: What kind of information is sent through fibers?

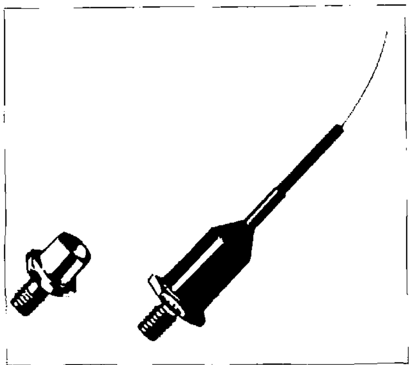


Fig. 6. Semiconductor laser diodes.

The answer is: Everything. Most fiber optics applications today are for digital data. Even when the information is analog, in most cases it is converted to digital data and then transmitted. There are a few instances where analog data is sent through the fiber by gradually varying the intensity of the light beam—cable TV is a prime example—but even this is likely to change to digital transmission as prices drop further and the technology improves. Digital TV is, after all, just around the corner.

When discussing fiber optic cables, we have also assumed that the fibers are straight, so that once a ray enters a certain mode, it stays there. In reality, fibers bend around corners and obstructions: cables hung on telephone poles will hang down between supports, and then have kinks at the point where they are attached to the pole. Even fibers that look straight have deflections that are large when compared with the wavelength of light. Light rays therefore tend to change modes inside a fiber all the time, and this does increase the attenuation as well as the dispersion.

This effect is actually increased by the construction of fiber cables themselves. Although a single strand of fiber might be fairly straight, strands that are embedded in thicker cables often lie in helical paths. They may be wound around a central metal cable which gives the entire assembly some strength, or they may lie loose inside a hollow tube, so the glass will not bend or break when the cable is heated and cooled.

One thing is certain—the last ten years have seen great strides in optical fibers. The quality has shot up, and prices have dropped. The result is that, for many applications, optical fibers are much preferable to copper wire.

Make a Ten-to-One Probe

Troubleshooting shouldn't be so much trouble.

Herb Foster AD4UA
3020 Pennsylvania Street
Melbourne FL 32904-9063

One of the most useful items of test equipment you can have in your ham shack is a cathode ray oscilloscope, more commonly called simply a scope. Now and then your scope, like any other piece of equipment, will turn up not working properly. Something has gone kerflooey and you find yourself troubleshooting. You don't have to go very far in troubleshooting one of these devices to run headlong into a problem. You'll find it necessary to measure the voltages on the several pins of the cathode ray tube (CRT) socket. In a bench service scope some of these voltages are on the order of a couple of thousand volts. There you have the problem. The digital multimeters (DMM) that most of us have on our workbenches generally won't test anything higher than 1,000 volts DC. You'll meet a similar problem if you need to dig into some linear amplifiers.

Time was when a good analog-type multimeter had a separate jack on the panel labeled "+5,000." You could put the positive probe into this jack and measure up to that level. This jack is missing on every modern DMM I've seen. What to do, then, when you need to measure, say, 2,000 volts?

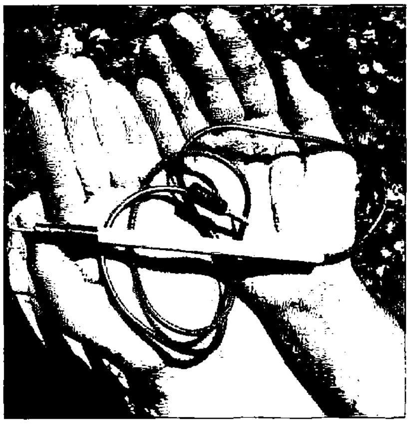


Photo A. The author's completed ten-to-one probe.

You need a probe that will divide the voltage by a factor of ten. That's 200 volts, and any DMM will read that with no trouble at all. This presents a *new* problem. I've never found a ten-to-one divider probe on the market. There are probes aplenty that divide by a factor of 100. TV technicians use 'em regularly. But 100–1 probes are generally very large, and although they are good for sliding under the ultor on a TV CRT, they are very unwieldy for poking around in a bench service scope. Ten-to-one probes just aren't there on the shelf. So I made one myself. It was easy and inexpensive. You can do it, too.

In making a voltage-dividing probe, the first thing to consider is the input impedance of your DMM. This is most often 10 megohms in the DMMs in use today. Yours might be different, but it's easily checked in the instruction book that came with it. You'll want to have 90% of the voltage to be measured dropped across your probe, and the other 10% across your DMM. So, if your DMM has an input impedance of 10 megohms, you need a probe that measures 90 megohms.

Most any parts supplier will be happy to sell you a handful of 10-megohm resistors. Buy nine of these in the 1/2 watt size. Tack-solder them together in a long series circuit, and measure the result. If your DMM won't measure such a big resistance, and many of them won't, see if it will measure 20 megohms. If so, you can tackle the string in portions. If it won't even do twenty megohms, you'll need to approach the problem from another direction.

Here we go

Find a place in some equipment you have that will produce a voltage of around 150 volts to 200 volts or so. The actual voltage doesn't matter much just as long as it's within range of your DMM, although in general, the higher the voltage, the better. Let's say that you have a point that measures 150 VDC. Let's call this the test circuit. Now connect one end of your embryonic probe—that is, the resistor string you just made, to that point and the other end to your DMM's positive jack. Connect your DMM's negative jack to the test circuit's ground. It goes without saying that *extreme* caution should be used here since everything will be exposed. The old adage that you should keep one hand in your pocket is not a bad idea. Also, make all connections with clip leads if you can. Then turn on the power into your test circuit. Take your reading and turn the test circuit off.

You'll have a string of nine resistors soldered together. One end will be connected to your voltage source (I like to use a lead of about 24 inches with an insulated alligator clip on each end). The other end will connect to a similar lead that will plug into your DMM. If you have exactly 90 megohms in your probe-to-be, your meter will read 15 volts. Most likely, it *won't* read this figure. This is where you must start juggling resistor values until you get the right reading.

Obviously, if your probe is over the required 90 megohms, the meter will be less than a tenth of the total resistance, and will read less then a tenth of the voltage. You'll need to bring the probe resistance down. By the same line of reasoning, if you have less than 90 megohms in the probe, the meter will

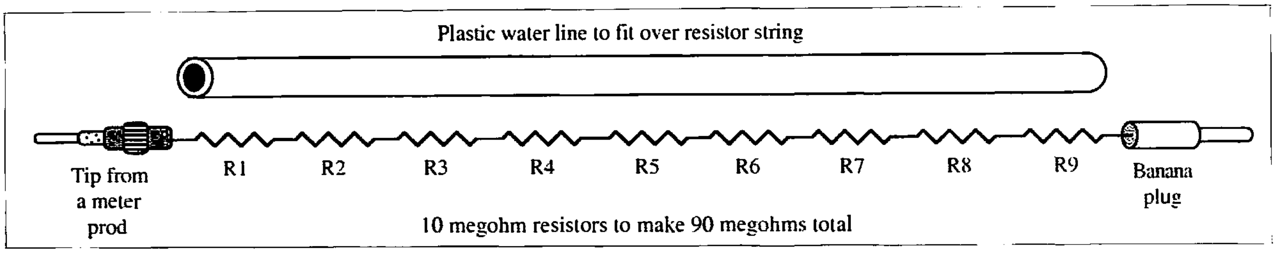


Fig. 1. Ten-to-one probe.

read higher than it should. It's easy to reduce the probe resistance by shunting another resistor across one of the series resistors. If the resistance must be increased, of course, you just add another resistor of suitable value on the end of the string. There's no cut-and-dried procedure in this. Sometimes it will help you get into the ballpark if you measure several resistors and try to line up nine of them that read very close to 10 megohms. Then you just use the well-known laws of series and parallel resistors until your DMM reads exactly one tenth of the voltage obtained without the divider probe in the circuit. In this manner, keep juggling resistors until you arrive at the desired reading. In our example that will be 15 volts.

In actual practice, if you can get about one-tenth of a volt under or over your target figure, you're close enough for any practical use. It helps to remember that a couple of resistors in parallel will always read *less* than the lower value of the two.

Having reached a satisfactory reading, turn off the test circuit and disconnect it from the probe you're making. Now you're ready to build the string of resistors into a real probe. Take the string apart and remake it, this time using short leads between resistors and using caution to avoid heating any single resistor unduly. Any heat on a given resistor might drive its value up and your probe won't read correctly anymore. A good dodge here is to wrap a damp cloth around the two resistors that you're working on at any given moment, leaving enough room to get your soldering iron in there. In this manner, you can use some very short connections and still avoid heating the body of the resistor. When you are done, check the resultant string again for the correct resistance, as you did before. There might a little more juggling to do to adjust for increased resistance anywhere in the string.

When all is A-OK, take a meter probe of any color and pull the probe tip out of the handle. Connect one end of the resistor string to this tip. Now set it aside, put on your plumber's hat, and take a trip to your favorite hardware store.

Plumbers use the word "water line" when speaking of the tubing that connects the cold water supply to the flush tank of a toilet. There is a type of water line made of a gray plastic which is slightly flexible. One end will be formed to enter into a fitting on the flush tank and the other end will be straight, for use in a compression fitting. The size of this water line will vary. Select one in the 3/8" size, of any convenient length. You'll want one somewhat longer than the resistor string you have waiting back on your work bench. These plastic water lines come in several different lengths. Just pick out one that's long enough. The length of plastic tube I needed was six inches. I bought one 20 inches long and cut the piece I needed.

Back in your shop now, cut off the end of the water line that has the shaped fitting intended for connection to the toilet's flush tank. This can be discarded. Next, cut the water line to a length a little longer than your resistor string plus the probe tip. This will probably be about six to eight inches.

Solder a piece of red probe lead about 30 inches long to the other end of the resistor string. Pick out a good grade of lead wire for this, bearing in mind that in use it will be carrying a few thousand jolts. Uh, that's volts!

Carefully slide your shortened water line down over the resistor string and onto the probe tip you attached to one end. It should be an easy fit, using hand pressure, to get the probe tip into the water line.

The far end of the lead finishes in whatever type of plug fits your DMM. Mine takes a banana plug. A dab of silicone rubber or any suitable cement will seal the rear end of the water line where your red probe lead exits. A short length, about an inch, of heat-shrink tubing placed over the probe tip will serve to insulate the tip somewhat, hold things together nicely, and make a fitting finish for the end of the probe. It may be necessary to use two to three sizes of shrink tubing, carefully selected, because the range of diameters from the rear of the tip to the actual point is quite broad. When the sizes and length of the pieces of tubing are selected and in place, you can bring them all to a nice shrink-fit by immersing the tip in a pan of boiling water for a few minutes to shrink the tubing, leaving a neat finish. When all the cement is set, and the water on the tip has dried, the work is all done. See **Photo A** for a view of how my probe looks.

One question that remains to be answered: What voltage does it take to puncture through the probe lead and also the water line? Most commercially-made probe wires have their rated voltage stated clearly. Good leads are generally at least five volts. Plumbers don't generally encounter such voltages, and plastic water line is not rated in this manner. Further, I lack the equipment to make such a test. I can only say that I've used my probe to check the focusing voltage of CRTs used in television sets, and this is around 5kV. At the same time, I observe certain common-sense rules, such as keeping one hand in my pocket, and making connections with alligator clips on a dead circuit, and then turning on the power to read the voltage. If I must handle the probe during the power-on condition, I hold it by the water line, since it seems to me it ought to have a higher voltage rating than 5kV. I've never been bitten yet. Anytime you work with voltages in the kV range, use *lots* of care. Truly, it is written: Electronic cooking is sometimes a slow process, and you might sizzle in your own fat for hours.

Put the completed probe in your toolbox and the next time you need to measure, say, 1.760 volts, you won't have to scratch your noggin and wonder if that voltage is OK. You'll know!

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Phased verticals?

Phased array antennas (at least in one form) consist of a pair of verticals spaced X wavelength apart (usually a half wavelength).They can produce a wonderful figure-8 pattern and show gain over a dipole. **Fig. 1** shows how a pair of verticals spaced a half wavelength apart react when fed in-phase and 180 degrees out-of-phase with each other. In **Fig. 1(a)**, the antennas are fed in-phase, so the two main lobes are found at right angles to the line between the two antennas. If the antennas are fed 180 degrees out-of-phase, on the other hand, as in **Fig. 1(b)**, then the pattern flips 90 degrees and is found along the line of centers between the two antennas. If you have a means of switching between 0 and 180 degree phasing, you not only get the gain but also the ability to control the direction of the main lobes and nulls (see "Author's Note").

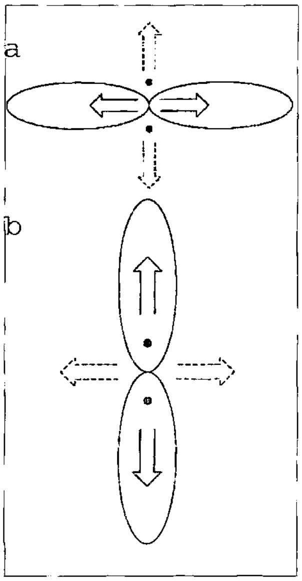


Fig. 1. Direction patterns for two verticals a half wavelength apart: (a) antennas in-phase (0°); (b) antennas out-of-phase (180°).

So now you want to build your own single-band "roll-your-own" phased array antenna. You rush out to the Harry and Harriet Homeowner DIY hardware store and buy an armload of aluminum tubing and go to work. When nearly completed, as you connect the coaxial cable between the two antennas, you find that the books lied to you: It's not possible to finish the job.

Why?

Well... let's consider the case where two verticals are spaced a half wavelength apart. The antennas are spaced a physical half wavelength apart (492/FMHz), but the coax must be an electrical half wavelength (492V/FMHz). The difference between the two lengths is the velocity factor (V) of the coaxial cable, which tends to be on the order of 0.66 or 0.80 depending on the type of cable used. Thus, the cable will always be too short to reach between the antennas. That's the critical fact missing in stories about the phased array.

Over the years there have been several ways to solve this problem. One method uses two different coaxial lines to the antennas from the receiver. If one is quarter wavelength and the other is three-quarter wavelength (**Fig. 2**), then the required phase shift is obtained by the extra coaxial line length. But extra coax causes increased loss, so the signal is not only not as strong as predicted but the patterns are distorted somewhat.

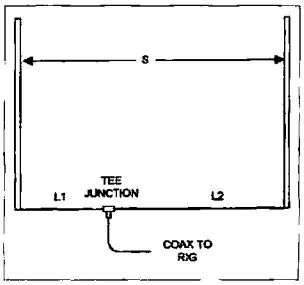


Fig. 2. One workable solution using different coax lengths.

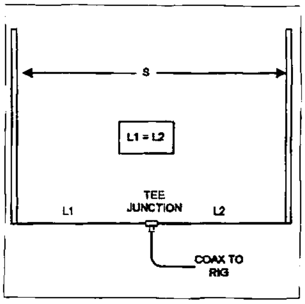


Fig. 3. Configuration of antennas using phasing box.

Well, there is one little trick that's a possible solution: see **Fig. 3**. Here we see two vertical antennas spaced S apart (for most people, I suspect S will be half wavelength, or 492/FMHz). A pair of identical length (L1 and L2) pieces of identical coaxial cable are used to connect the two verticals to a phasing box. Note that it's not important just how long those cables are, but that they be precisely, exactly and really the same length as each other. The phasing box is, in turn, connected through a third length of coax (actual length unimportant) that goes to the receiver.

If the phasing box is made switchable, then both in-phase and out-of-phase conditions can be satisfied. **Fig. 4** shows the circuit for a phasing box that I've used. The innards consist of a transformer in which three windings are wound "trifilar" style on a toroidal core. Almost any HF band toroid can be used, but I used the Amidon Associates type T-50-2 (RED) or type T-50-6 (YEL) cores for this type of project. Use fifteen trifilar turns of #14 AWG enamel insulated wire around the toroidal core. A DPDT toggle switch is used to select either zero or 180 degree phasing for one antenna input (the other input remains constant). A pair of "three-way" AC power switches can be ganged together to form a DPDT switch with RF capability.

So what's a "trifilar turn"? Good question; see **Fig. 5** for the answer. In trifilar winding three wires are kept parallel to each other as they are wound on the transformer core. Although a linear "rod" core is shown here, a toroidal core can also be used.

An improvement in the transformer can be made by using a special transformer called a hybrid combiner transformer. Perhaps in the future we will examine that subject as well.

A bit of a safety note

Both forms of phased array feed system shown in this article could involve laying coaxial cables along the ground surface or possibly elevated at levels where pedestrians could strike them. It is important that you take whatever steps are appropriate in your particular situation to ensure the safety of people passing through your property. If this means burying the coax, then bury it.

Responses

My recent columns on science fairs and ham software have produced a lot of E-mail for me. Almost all of the software comments were a hearty "amen!" and I find that quite satisfying. One chap wrote to me and asked what tools were available to write Windows© software (ham or otherwise). The tool that I use is Microsoft's Visual Basic

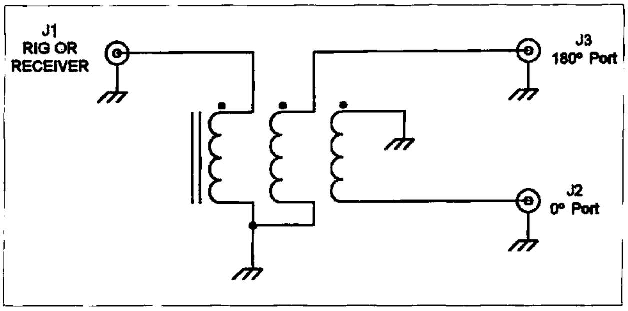


Fig. 4. Circuit of phasing box.

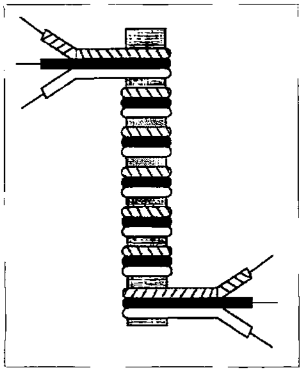


Fig. 5. Trifilar winding scheme for toroids.

language. I currently own VB 3.0 and VB 4.0, and by the time you read this will own VB 5.0. The VB 5.0 version includes a true native code compiler so programs written in that language will execute about 20 times faster than VB 3.0 or VB 4.0 programs. This feature should answer the objections of people, like producers of antenna simulation and modeling software, who complain of the slowness of early VB editions for computation of intensive programs. If you plan to write software for the ham market, then I recommend either VB 4.0 (for those who must write for Windows 3.1 environments) or preferably VB 5.0.

The science fair article generated several responses. I am heartened that the "elmering" ethic is still alive and well among hams. The next generation will only be as good as we make it... and role models are what kids need. Besides, we might generate a few new licensees.

Author's Note: Other patterns and directivities are obtained when different phasings are used. See the pattern charts created by Brown prior to World War II. They are reprinted in The ARRL Antenna Handbook (any recent edition). 73

NEVER SAY DIE

Continued from page 53

government, our school system, our medical system, and so on. My cries of alarm are just annoying to most people, so I should shut up and go along. I should stop trying to get people to live longer, healthier lives. I should shut up about how to raise healthier, brighter children. Kids are okay, as long as they're not too much trouble.

And I should stop fretting about amateur radio losing its future to commercial interests, with its potential for growth and a payback for the use of our frequencies via a reborn electronics industry ignored by the League and our ham clubs.

Rome was destroyed by two things: the government deficit, which collapsed the empire, and the games which kept the people so busy enjoying themselves they ignored the government's folly. Today we are far too involved with ball games, sitcoms and soaps to participate in our government. So, through our neglect we have lawyers writing our laws for their benefit, and our judges are ex-lawyers. Great system... for lawyers.

If one of the many promised millennial cataclysms doesn't do us in, maybe our government will. There have been a string of empires down through history; all have collapsed, and none has ever made a comeback. Look at the Egyptians today! The Greeks! The Romans! The Spanish! The British! All had world-dominating empires at one time.

Revolution!

Yes, I'm preaching revolution. No, not with terrorist activities or an armed insurrection.

Having visited most of the major countries around the world, I can safely say that the US is the best of a sorry lot. But, on the other hand, that's not saying much, considering the major miseries we're suffering. Our school system is one of the worst in the world, a great example of socialism gone berserk. Our so-called health-care industry is an international shame, despite its astronomical ($1.5 trillion) cost. We have the highest percentage of our population in prison of any country in the world. We have a huge drug problem, despite the billions of dollars wasted pretending to fight it. And these are things that directly affect every one of us. Our legal system is a joke. Many of our judges are a joke. Our food supply system is making us sick, and so is our public water supply. Our paper "legal tender" is in the hands of an international conspiracy.

Our diet causes endless cavities which our dentists fill with mercury. Did you know that in a survey 96% of the multiple sclerosis patients were found to have mercury poisoning from their fillings?

If you're like most Americans you've been so brainwashed in public school that you have little initiative or motivation to help yourself, much less want to help others. You are sedated with ball games, sitcoms, soaps, rock music, alcohol, tobacco, brainless movies, and so on. When is the last time you read a book and really learned something? It's a heady experience.

With motivation there's almost nothing you can't do. You can take up horseback riding and become an expert rider. You can teach yourself to write, to compose music, to sculpt, to paint.

You can be totally healthy and not have the slightest worry about a heart attack, a stroke, cancer, and so on. But you'll need to start doing your homework. You're not going to be healthy if you keep on eating the same old garbage and drinking city water. This will take at least 20 years off your potential healthy life and probably make your declining years hell.

You could be making all the money you want, but not if you haven't broken loose from "the system." You probably, like me, got sucked into going to college. Four expensive, wasted years. At least the government paid for my last two years. That was part of their plan to keep millions of discharged soldiers and sailors from suddenly being dumped on the employment market when WWII ended.

College is great: you learn very little, have a great time for four years, and then you're suited for employment in a large corporation, by the government (if you can't make it in industry), or you teach. That's part of "the system." Those jobs have one thing in common: you'll never make much money. You'll never know freedom.

The revolution I'm preaching is self-education. Reading books and learning. Getting not just good at your work, but one of the best in the world at it. Bringing up a prize-winning child. Get to be an expert on more and more things and then start teaching and inspiring others.

We need kids in amateur radio. So what have *you* done about this? What has your club done? We need a million new young hams. Ten million.

In my editorials I've suggested ways to eliminate the drug problem, to cut our prison costs by around 75%, to cut school costs by at least 50% and enormously improve them, to make college tuition-free, to cut our medical costs by 80%, to get our government bureaus to enthusiastically cut themselves in half in three years, and so on. Hey, am I the only one proposing solutions to our problems? How about you? Do your homework and see what you can come up with. What did you think of my plan for making foreign aid into a profit center for the country?

Good PR

KD6CNU was kind enough to send me a copy of a half-page article about hamming

Continued on page 79

Number 71 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

Getting started with the right tools

Apparently 100 isn't my lucky number. After 99 successful column submissions, the first section of last month's "Homing In" never made it from my computer to *73*'s.

Let's fill in the missing information. "Homing In" for May was the first of a two-part series describing the wide variety of tools available for radio direction finding (RDF). Most are quite inexpensive and make use of receivers that you probably have already. Two meters is the most popular band for RDF activities, so that is the focus. Most of these techniques can be adapted to the 223, 440 and 1200 MHz bands. They are not suitable for bands below 60 MHz, however. That's a topic for another time.

Beams track the weak ones

Directional antennas are easy for everyone to understand and use. We all learned at an early age to point a rooftop TV antenna at the TV station's tower for the best picture. Today's kids are learning how to aim a satellite dish in the same manner. Mobile RDF with a beam antenna is just as easy and intuitive. An old two-meter yagi from the flea market may be all you need to get started.

A simple two-element beam (driven element and reflector) is sometimes adequate, but most mobile T-hunters prefer three- or four-element models because their forward lobes are much sharper. You will use the forward lobe as your direction indication most of the time—not the nulls in back—because sensitivity and accuracy are best in the forward direction.

Two companies make yagis that are particularly well suited to mobile RDF. All models from Swiech Communication Systems are rugged and have a flat black anodized finish. This makes them "stealthy" for night hunts; you will get fewer stares and interruptions from passers-by. Yagis from Arrow Antenna Company have elements made from the same material used in aluminum arrow shafts for archers (**Photo A**). These rods are about half the weight of ordinary tubular aluminum elements of the same diameter. As a result, Arrow's antennas are lightweight and easy to aim, mobile or hand-held.

Cubical quad antennas have about the same gain and directional pattern as yagis of the same number of elements and boom length. Many mobile T-hunters prefer quads because a vertically polarized yagi is taller and more of a tree snagger. VHF quads are easy to build at home with just a few dollars worth of ordinary PVC plumbing parts and wire. Complete plans for "strung wire" and "stiff wire" quads are in *TRANSMITTER HUNTING: Radio Direction Finding Simplified* by Moell and Curlee. This 323-page illustrated text, hereafter called "the T-hunt book," is available at ham radio dealers and *73*'s Radio Bookshop.

If you don't want to build your quad at home, consider the inexpensive four-element two-meter models from Cubex Quad Antennas and AAE Bandmaster Enterprises (illustrated last month). Both feature Fiberglas™ spreaders with arrow nocks at the ends to hold element wires. If you want to disassemble your antenna between hunts for storage and transport, it's easy to do so and equally easy to put it back together again.

Last month's "Homing In" explained why adjustable polarization of yagis and quads is important, and how to achieve it. I also covered Doppler RDF sets, their good and bad points, and what sources are available for purchasers and home builders. Finally, I described simple techniques for getting bearings when you get out of your car to "sniff" (close in on foot), including offset attenuators and tracking on the third harmonic.

Buzz boxes, a sniffing alternative

Dual-dipole RDF sets such as the one in **Photo B** are popular in many localities. Also called "homing sets" and "buzz boxes," they feature a pair of dipole antennas separated by a half wavelength or less, a switching device, a receiver, and a left-right indicator such as a zero-center analog meter or a pair of LEDs marked LEFT and RIGHT. They are easy to use: Just turn the unit to the left when LEFT is indicated and turn it to the right when RIGHT is indicated. There will be a sharply defined crossover of the indicator when the unit points directly toward the signal source.

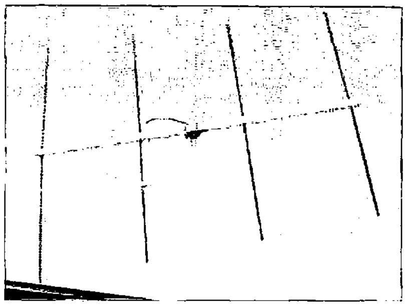


***Photo A.** Arrow Antenna yagis use lightweight arrow shaft elements screwed into a hollow aluminum boom.*

The venerable L-Per by L-Tronics (illustrated last month) is the most popular dual-dipole set among hams who assist the Civil Air patrol and other agencies tracking aircraft Emergency Locator Transmitters. The L-Per uses a switched-pattern principle and includes a built-in AM receiver. This receiver can also be used to track two-meter FM signals if crystalled for a signal's frequency.

Most of the other dual-antenna RDF sets you will encounter use a different principle called either narrow aperture time-difference-of-arrival (TDOA) or phase-front detection, depending on how you prefer to explain the physics. TDOA sets are favored by hams because they are add-ons for existing VHF-FM receivers and can cover a wide frequency range.

The first TDOA RDF device for ham radio was the Double Ducky by David Geiser WA2ANU. An improved version of it, called the Simple Seeker, is detailed in the *ARRL Handbook*. A TDOA design by Paul Bohrer W9DUU in the July 1990 issue of *73* is popular with home builders. Commercial left-right TDOAs include the SuperDF SDF-2 by BMG Engineering, the Vector-Finder VF-142Q by Radio Engineers, and the Foxhound DF-1 by Ramsey Electronics. In my tests, the SuperDF performed best; its synchronous detector excelled in suppressing the effects of voice and other modulation on the received signal. Avoid any buzz box that doesn't have two vertical dipoles and a method of sensing left versus right.

The one-piece configuration of most homing sets makes them well-suited for sniffing in the brush, but awkward for mobile use. The SuperDF is the only one designed to facilitate mobile use by mounting the antenna set on an outside rotating mast and locating the left-right indicator on the dashboard.

The sharp crossover indication of a TDOA is much sharper than the broad lobe of a beam. TDOAs are remarkably sensitive, but don't expect them to compete with yagis or quads when the signal is weak. When signal reflections are severe, indications will be less reliable, but you can usually use them successfully if you keep moving and mentally average out the readings.

Like Dopplers, TDOAs give no indication of signal amplitude. This is an advantage when signal level varies and means you don't need an RF attenuator with your TDOA. But it also makes it more likely that you will walk by or over the hidden transmitter without realizing it. TDOAs are also similar to Dopplers in that sensitivity and accuracy is degraded when the target signal is horizontally polarized.

Transmitter hunting is an acquired skill. No RDF set always gives accurate unambiguous indications and leads you unerringly to the target. The more you use your equipment, the more you'll understand its strong points and limitations, and the "luckier" you'll be. For your first effort, track down the local repeater as if you don't know where it is. Then get a friend to drive somewhere and transmit to you while you try to locate him or her.

After you've learned the basic techniques, you're ready to get competitive—all in fun, of course. Arrange with your club to hold

some hidden transmitter hunts. The first few should be easy so that everyone is successful and encouraged. The signal should be strong and the transmitter should be in plain sight, perhaps in the parking lot of a restaurant or at a table in a city park.

With time, hunts will get more challenging as the skills of hunters and hiders increase. You will probably want to develop some rules to even the match between hiders and hunters. Some groups are strict about the hidden T's antenna polarization, power variations, and nearness to paved roads. Others say, in effect, "Anything goes!"

Some clubs like to run the hunt like a rally, requiring the winner to have lowest mileage from the common starting point to the end. They say it discourages reckless driving, encourages careful triangulation, and evens out the competition. Sometimes the last team in is the winner, prolonging the suspense.

Other groups use elapsed time as the winning criterion. They say that time is of essence in a jammer hunt or search-and-rescue operation, so hunters must learn to find transmitters fast. Furthermore, in a time hunt there is no need to worry about the accuracy of competitors' odometer calibrations. In a few places, the hider sets the rules and they are different for every hunt.

In some areas, hunts for multiple transmitters are common. In others, one well-concealed rig is enough. Most of the time it's every team for itself, but in a few towns there are cooperative hunts on repeaters where bearings from base stations are welcome. For lots of suggestions about organizing T-hunts and making rules for them, see the T-hunt book.

Fool 'em with Mother Nature

The great attraction of T-hunting is that when you set out on a hunt, you never know where you will end up, and you never know what you'll find there. In an E-mail message last fall, Bud Hughes K4CWG of Titusville, Florida, described how John Munsey KB3GK used an antenna that was visible, but invisible: "John dug a hole and buried the transmitter, then ran the coax underground about 15 feet from the rig to a tree. Somehow he attached the center conductor to the tree, about six inches below ground level."

On a hunt like that, even a beginner can figure out that the signal is coming from the forest, but once there, who would suspect it's coming from a tree? "To my surprise, the sniffers detected quite a strong signal coming directly from it," Bud wrote. "I was taught to believe that trees don't radiate. So much for that." The 20-minute videotape of T-hunters inspecting and re-inspecting the tree made for a great program at the next radio club meeting in Titusville.

Two-meter T-hunting has taken place here in southern California for decades, and some T-hunters have been participating since almost the beginning. These veterans want to do more than just find a ham sitting in his car at the end of a street. Some of our evening hunts involve several transmitters and the boundaries extend over forty miles in some directions from the start. The monthly "all-day hunts" usually have no boundaries at all, except for the US border. They start Saturday morning and sometimes aren't over until Sunday evening.

Many all-day hunts take place along mountain trails and desert washes, making four-wheel drive a desired feature in your T-hunt vehicle. A good example of a typical all-day hunt was February's event, when longtime T-hunter Bob Thornburg WB6JPI put three transmitters along the San Sevaine Truck Trail. This road, if you can call it that, meanders for 26 miles through the mountains of the San Bernardino National Forest, beginning in Alta Loma, 35 miles east of downtown Los Angeles.

The Forest Service gate onto the road from Alta Loma was open, but the gate at the eastern end was locked tight. Bob turned on the easternmost transmitter a half hour early, and it was the only one on for the first hour. He wanted to draw the hunters east so they would find the locked gate and then have to drive all the way back through the flatlands to the Alta Loma end.

The main T ran 30 watts and was located in the middle of the Joe Elliot Campground. "You could drive and park on top of the transmitter," Bob wrote. "It went into a switchbox that selected one of eight antennas spaced over an area of about 200 by 200 feet. The antennas were AWG #30 green magnet wire that came out of the ground and tangled into a convenient bush or tree trunk. The antennas were scanned at a 1.25 Hz rate. Transmissions were twelve seconds long every 40 seconds, so each antenna was on about one and a half times per transmission.

Photo B. Igor Krivosheev UWØCZ learns how to use a SuperDF dual-antenna set by BMG Engineering as he prepares for an international-style radio-orienteering contest in Portland, Oregon.

"It took 800 feet of coax in all," WB6JPI continued. "The eight antennas were simply not visible, even if you knew where to look. It was my intention that some hunters would camp there. It is a really pretty place and the view is dramatic. But the diversion to the eastern end and having to creep up the terrible road made the timing such that no one stayed. At least I don't think they did.

"The two other transmitters were 'throw-outs' along the trail. One was leaning on a tree about 10 feet off the road and about four feet beneath it. The other was located on top of a hill about two hundred feet from an even more difficult spur off the trail. It was 2.17 miles from the first T, but took about an hour to get there."

Bob's tongue-in-cheek write-up on the southern California T-hunt Web site relates tales of three-foot-deep Jeep-swallowing washouts, large rocks (one three feet in diameter), four-foot humps and a couple of full-fledged landslides. "Don Lewis KF6GQ told me via E-mail that it took him six hours to go up and back down," says WB6JPI. "After my five trips for planning setup, and observation, I got it down to four and a half hours. It helps if you know you can do it without falling off the cliff. Luckily, I don't win very many hunts or none of us would have any vehicles or equipment left."

Do you have an unusual T-hunt story for "Homing In" readers? Drop me an E-mail message or write to the address at the beginning of this article. Next time you're surfing the World Wide Web, be sure to visit the "Homing In" site [http://members.aol.com/homingin/]. Don't forget the trailing forward slash.

This month's RDF resources

AAE Bandmaster Enterprises
3164 Cahaba Heights Road
Birmingham AL 35243
(205) 970-0622

Arrow Antenna
1803 S. Greeley Highway #B
Cheyenne WY 82007
(307) 638-2369

BMG Engineering
9935 Garibaldi Avenue
Temple City CA 91780
(818) 285-6963

Cubex Quad Antennas
2761 Saturn St. Unit E
Brea CA 92821
(714) 577-9009

L-Tronics
5546 Cathedral Oaks Road
Santa Barbara CA 93111
(805) 967-4859

Radio Engineers
7969 Engineer Road, Suite 102
San Diego CA 92111
(619) 565-1319

Ramsey Electronics
793 Canning Parkway
Victor NY 14564
(716) 924-4560

Swiech Communication Systems
12218 Greentree Road
Poway CA 92064
(619) 748-0708

Number 74 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Hoo boy! It looks like the period between June 15th and 18th may be very exciting indeed! In particular, the 16th and 17th look terrible from the standpoint of high HF signal absorption (elevated Ap and Bk values as reported by WWV), and an active magnetic field reaching storm levels at times. Although the four-day period may be delayed a few days past the predicted times on our chart, it will be best to keep an ear tuned to WWV—if, indeed, you will be able to hear it—during the forecast period.

Although in June the Earth is farther from the sun than it is in December, the northern hemisphere is tilted toward the sun, which gives rise to the expected doldrums on the HF bands, so plan to do your operating during the first week or so of the month and again between the 22nd and 25th. As I write these words, the 10cm solar flux remains at very low levels, and that, coupled with seasonal lows, doesn't provide much hope for June DX.

There is always a "however" coupled with propagation reporting—sort of an escape route by which forecasters can occasionally avoid tar-and-feathering by DXers—and that is the very low sunspot and solar flux activity itself. During high sunspot activity at the peak of a solar cycle, Good (G) days and Poor (P) or Very Poor (VP) predictions are usually fairly accurate; but during the bottom of an old sunspot cycle and beginning of a new one where we are right now, magnetic field and ionospheric disturbances on Earth, caused by possible solar flares or other solar disturbances, can often jump-start HF propagation, and certainly boost VHF propagation.

So, gloomy as those mid-June days appear to be, don't ever fail to keep listening on your favorite DX bands, because pleasant surprises occur when least expected. Monitor WWV carefully at all times.

JUNE 1997						
SUN	MON	TUE	WED	THU	FRI	SAT
1 G	2 G	3 G	4 G	5 G	6 G	7 G
8 G	9 G-F	10 G-F	11 F	12 F	13 F	14 F-P
15 P-VP	16 VP	17 VP	18 VP-P	19 P-F	20 F	21 F
22 F-G	23 G	24 G	25 G-F	26 F-P	27 P-F	28 F
29 F-G	30 F-G					

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

Band-by-band propagation this month

10–12 meters

Occasional intense sporadic E propagation may provide openings to 2,000 miles or more, while frequent short-skip openings out to 1,000 miles or so can occur on Good (G) days.

15–17 meters

Frequent short-skip openings to 1,500 miles and occasional long-skip openings on north-south paths across the equator are expected on Good (G) days.

20 meters

DX to all parts of the world can be expected on this band from sunrise to sunset on Good (G) days, with peak conditions usually occurring a few hours after sunrise, and again in the late afternoon. Short-skip to 2,000 miles or so may be expected as well.

30–40 meters

Consistent nighttime DX to all parts of the world is expected from sunset to sunrise, with possible exception of poor reception due to high static levels during thunderstorm activity. Short-skip openings averaging 500 miles during the daytime and 1,500 miles at night are anticipated.

80–160 meters

Nighttime DX on 80 and 160 can be fair this month, with the exception of high noise levels on both bands from thunderstorms. Daytime short-skip of a few hundred miles is possible on 80 but not on 160. Short-skip propagation is expected at night on each band and ought to be fair out to perhaps 1,400 miles or so, although limited by QRN. 73

Hams with Class

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Food for thought

Any teacher who is using ham radio in the classroom as a motivation into the other curriculum areas knows that some of the best lessons can be tied into the social studies program. About once every two years I take a deep breath and let my 6th, 7th, and 8th grade radio students do the famous "foods project." It's such a great radio/geography exercise that I put up with the mess it tends to create.

The last time I did this, the 8th grade decided to make a papier-mâché globe which they would fill in with foods, spices, and grains indigenous to each area we contacted. The other two grades went out and got a roll of brown butcher paper and drew a large map of the United States on it. Their plan was to fill in major regions of the country we had contacted on the air with the appropriate foodstuffs.

Since many of the children in my classes come from families that have settled in Staten Island, New York, from other countries, we decided to use their own families as a major resource. The parents were more than happy to help the children locate specific spices and grains that represented the area on the globe they had come from—and it's always a good idea to include your students' parents in a project whenever you can. It's the educationally smart thing to do. It also doesn't hurt that you'll be gaining support for your radio program.

Of course, the obvious resource we also turned to was the radio. Whenever we made a contact with a citizen of a region that we still needed help with, the children would interview the ham radio operator and enlist his help. As is always the case, the hams we contacted were delighted to help out. They were supportive of the project when the children explained what they were doing in class. The school's mailroom soon became flooded with interesting packages and letters from all parts of the world. Students would stick their heads into my room each morning to see what had arrived that day in the mail for them. It was a very exciting period.

I knew I was on the right track with this project when one young girl said to me, "It's a lot more fun to talk directly to someone to get information than to look up facts in some yucky textbook."

***Photo B.** L to R: Jordan KB2PYS, Carole WB2MGP, Renée KB2QMR.*

I thought that my Halloween pumpkin-globe project created a mess in my room, especially when the painted pumpkins began to decompose. The mess involved with the papier-mâché put the pumpkin project to shame. I definitely suggest that you get your cleanup squad well organized before you attempt this one. I was stepping on peas and seeds for weeks.

"I was stepping on peas and seeds for weeks."

I eventually wound up breaking up each class into teams. I appointed a glue squad responsible for the neat gluing of the grains, spices, and food samples on the globe and on the floor map. Another team was responsible for the proper labeling and storing of the perishable items. I did class lessons for all the students to verify the accuracy of the items we were collecting. By the end of the third week, our ham shack looked like the inside of a food warehouse.

Because of previous lessons we've had in ham radio class, my 7th and 8th graders knew about writing to foreign embassies to get more information. It was gratifying to see some of last year's licensed youngsters so at ease with some of the more sophisticated research techniques they had learned in radio class. I was very proud of them.

The large paper map of the United States was a little easier to control because I insisted the kids use crayons and magic markers instead of paint. They were creative enough to figure out themselves that as the deadline drew near, it was acceptable to draw a small illustration, or to write in the names of the grain or spice they were unable to locate. By the time we were at the end of this project, we had managed to fill in 90% of the globe and map with actual substances.

Every time we do this geography activity, my students have fun making up puns to tell other hams on the air. They would tell other operators that they were engaged in a very "tasteful" geography project; or that their teacher was giving them some "food for thought."

The children definitely become more worldly when immersed in these fun geography lessons that are a natural outcome of speaking on the radio. The world is indeed becoming smaller, and ham radio is the perfect tool to bring the world into the classroom. If you have had success incorporating ham radio with geography and/or social studies lessons, please write to me so we can showcase your work and share the good ideas with other instructors.

***Photo A.** Letters and packages arrived daily from all over the country and different parts of the globe. It was very exciting!*

Number 76 on your Feedback card

THE DIGITAL PORT

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703

Last month I talked about using your software and your packet station to connect with your local ham BBS and promised I would give some hints about getting up and running.

When we, as hams, see something we want to do, we persevere until we succeed. The paths we take, though, are almost as different as fingerprints. Some hams like to really get to know their equipment and enjoy home-brewing every part of it they can. Other hams detest reinventing the wheel and simply want to get on with the show. Cost is often a deciding factor. There is something for sale on every corner for the digital modes and your decision of what to get is personal. Not all hams have equal tastes.

There is a place and a product for everybody and I will cover as much territory as I can. I mentioned that I was using one of the commercial products (AEA's PPWIN) last month. That is a do-everything style of program that was easy to get up and running, but, sadly, AEA is no longer with us.

Though it is easy to get started, if you need to do some special configuring, you may find a few hurdles in your way. I haven't found an insurmountable problem with my system, but I have had to do a few logic sessions with it to look into the mind of the programmer who wrote it. After any of those sessions, I have always had to admit to myself that the programmer was a ham and he really wanted everything to work for us. One of the reasons I have that program is because I have the AEA PK-232MBX and it seemed logical to use software from the same supplier.

Some alternatives

Kantronics and MFJ supply some of the standard widely-advertised equipment in use by a vast number of hams. Some of you will simply want an elementary packet station. There are some good deals for you as well.

My first packet station was built around an MFJ-1270 with a Commodore 64. The software furnished with the MFJ was adequate. I found some that performed more to my liking and the whole setup cost me less than $200. I still have that equipment and put it to use in another location for a year or so. For bare-bones packet, MFJ can get you going for a modest price.

If you should happen to acquire a bargain Terminal Node Controller that has no software, there are a number of good programs available at the right price. Winpack is a packet-dedicated program that runs under Windows© and it can be downloaded from a number of sites. I downloaded it from CompuServe, which often makes a better connection than some Internet routes and is therefore quicker (under 15 minutes with a 14.4 bps modem).

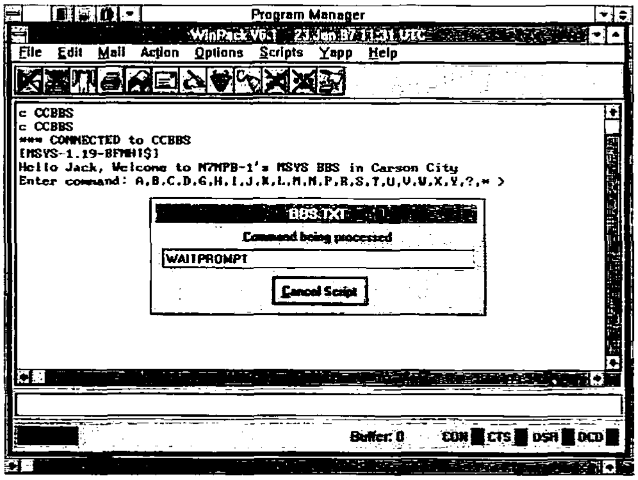


Photo A. Winpack connected to my local PBBS, showing the welcoming text and list of commands.

The file name is WINP610.ZIP; there are earlier versions that will be on some of the servers. I unwittingly found an earlier version in the CompuServe library and it didn't download. Lucky day—the header was there but no file. It forced me to find the correct file, which can also be downloaded from the TAPR website.

The author, Roger G4IDE, has apparently not been demanding payment for the use of the program, but since he found some of the shareware merchants had been charging for it, he has requested that we consider registering the program for £10 (ten pounds) UK—I think that translates to less than $20 US. Yes, it is written in Lincolnshire and you will get a little flavor of British wit when you read the on-line documentation.

Between the "Read Me" file and the "Help" file, there is ample information to get it up and running—maybe because the author readily admits that my PK-232 can be difficult to communicate with by way of his software: it was another program I had to get very close to before I got all its ducks in a row.

Once it began to play, it played very well. Some of its strong points are that you can have automated sessions to log onto the BBS and get your mail and search for predetermined bulletin headers and when it has done its chores it logs off with the mail and bulletins all neatly pigeonholed. It is a neat piece of work that does the job on packet the way you tell it to. See **Photo A**.

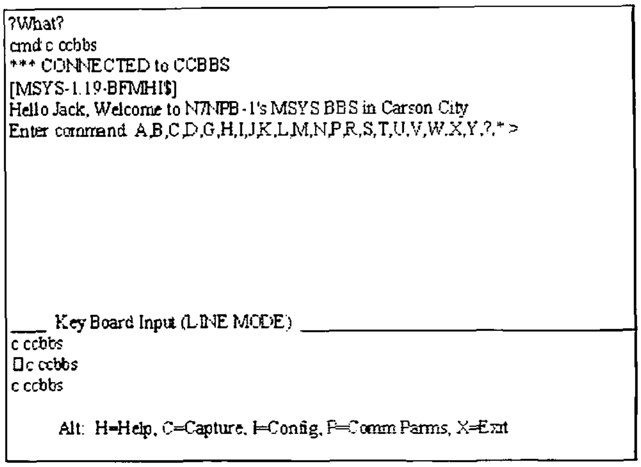


Photo B. Packcom screen, with split operation.

For the keep-it-basic operators, there is a small and very easy to use DOS program free for the download. I found it in the Hamnet library on CompuServe. It is Packcom and the zipped version is a little less than 60K. After downloading and unzipping, the program only takes up about 125K on your hard drive—and I found it will run under Windows, so you can run it without exiting to DOS.

I didn't time the process, but I believe I spent a total of 20 minutes getting the program set up and connected to my local PBBS. The program was written in 1987 by Jim WB4ZJV. It has a few bells and whistles and they are just the right combination. There is an alarm sound when it connects and a tone when disconnect is signaled.

The program parameters are a snap to set. It has on-line help, but the program is intuitive enough that you may never need to bring up the help. **Photo B** shows my first connection to the local PBBS.

If you go after this program from the CompuServe libraries, it is in Hamnet, Library 9, and it is named "PACKCO.ZI" which is the only hint of error I found. Something must have gone wrong

at the library end—I found it would not unzip until I renamed the file "PACKCO.ZIP" and from then on, the process was flawless.

If you are thinking of buying a TNC and software, there are several available. According to the ads, MFJ's 1270C comes with packet software and the price is right at $120. As I mentioned last month, I have one of those: it's done a job for me from time to time and has survived some punishing surges in the local power lines as well as many days at a time of continuous duty. MFJ claims to have both DOS and Windows software in the package.

Another company to consider: PacComm has a similar package. The company produces a broad line of digital equipment, and one of their offerings is a dedicated packet TNC that comes with software for $129.

There is one area I haven't touched on, and, for some, it could be the most important part of this column. That is hooking up your TNC to your radio. The TNC to the computer is usually a simple cable connection, but the TNC to the radio offers some resistance.

The TNC must get a signal from the radio that there is a data carrier present so it will wake up and decode the incoming carrier. The TNC, among all its duties, must be able to tell the radio to transmit at the correct time. The hookups to allow these processes are not necessarily easy without proper instructions.

Usually, if you purchase a new TNC and you have a popular brand of radio, the instructions for making up the cable to mate these two pieces together will come with the TNC or cables will be readily available for purchase. However, with used gear, there are too many combinations—almost every combination of TNC and radio have been mated by someone somewhere—to describe them all here. Fortunately, this information has been recorded and it is available. More next time. 73, Jack KB7NO.

LETTERS

Continued from page 61

I will concur that CW could be considered an art of sorts, but those who insist on its use at high speed as a filter to limit access to the HF spectrum are arguing in conflict with our charge to advance and improve our skill pools. If a National Pilots Association's goal was to increase the number of trained pilots and enhance flying technology I don't believe this would be met by requiring members to master hang-gliding techniques before they could use foreign airports.

Mr. Hanlon's bigoted thinking that we even need a filter is not surprising given the self-perpetuating nature of our hobby and its leadership selection. These "leaders" are again willing to gamble our future existence by maintaining a filter hopelessly hobbling our true potential based on the pre-destined results of a misleading, biasedly designed and badly worded "survey," not on any logical premise. Where were the questions about their current abilities and usage of CW? Where was the essay question requiring a person to support their answers with data of facts on how CW's requirement contributes to, detracts from, or is in any way necessary to participate in the service on the HF frequencies?

It seems that most hams have forgotten that primarily we are supposed to be a technically progressive service. All of us have inherited different gifts/talents. Some can be developed more than others. For many this is not a matter of being lazy or unmotivated. No amount of training will allow the truly uncoordinated to dance like Fred Astaire or enable the crayon-challenged to paint like Rembrandt or the tone-deaf to sing in harmony. But these people should not be restricted from pursuing an interest, in all its areas, that by definition is technical in nature, that is now controlled and mostly populated by those who can dance, paint, and sing.

The vast majority of the public would not pick up and use one of our licenses if they were given away on street corners. A true no-code-required, technical-based licensing system would be more than necessary to limit our hobby and band usage to the technically gifted (and hopefully innovative) users for which it was intended. With pieces of our bands being slowly whittled away for use by other services we should be looking for every possible way to attract technically motivated newcomers to our hobby and to finding new ways to reestablish ourselves as a true service, to ourselves and to our communities and nation.

Boyd Cantrell KC7JUZ, Albany OR. Most radio amateurs are not aware of the fact that the written test for their license is more difficult than the written test for a Private Pilot's License. The pilot's test consists of 60 questions. Each one has three answers to choose from. You must get 40 correct to pass. Statistically, you may guess all the answers and get one third of them correct, so if you know 20 answers you can pass.

Now the test for a basic entry level amateur radio license (no-code Technician) consists of 55 questions, with four answers each, so you can guess only one fourth of them, and you must get three-quarters of them (41) correct to pass.

If you pass and get your license you are still not really considered a ham unless you can use Morse code. Most amateurs want the General class license. That means 80 questions of which you must get 60 correct and do 13 wpm of code. That 60 is 50% more than the 40 required for a pilot's license, not to mention the Morse code which many intelligent people can not master. There are doctors, lawyers, engineers and people from all walks of life who can not get a handle on it. It is something that you just have to have a knack for. It is not even a technology—it's a psycho-motor skill which is outdated and no longer needed. The code requirement has been dropped by the US Army, Navy, and Coast Guard, as well as others, but the FCC, in trying to please a minority group known as the ARRL (which is composed of only 23% of the radio amateurs in this country), requires code proficiency for you to get a decent license.

I guess the reason that the amateur test is more difficult than the pilot's test is because the FCC doesn't want the hams to be crashing their radios into schoolhouses. I am not trying to show how silly the FCC looks, but I *am* trying to show how they have bent over backwards all through the years in trying to please the ARRL. More people are killed by private planes than by radios each year, so there is no rational way to justify the fact that a test for amateur radio is more difficult than a pilot's test. And then for the FCC to require proficiency in Morse code on top of it is on the border of asininity if not insanity.

Number 78 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

One way or another, we hams have often found ourselves at the forefront of technology, or at the crossroads of one mode and another. While many arguments can, and have, been made for or against the influx of the Internet into ham radio, one cannot deny the influence. In fact, if there is one thing maintaining the RTTY Loop Home Page has taught me, it is that there is a wealth of material directly of use to the radio amateur out there, if only it could be found efficiently.

The Radio Guide

Joerg Klingenfuss has come through, once again, with a book that neatly fills a niche in the amateur library. His new book, *1997 Internet Radio Guide*, shown in **Fig. 1**, takes on a monumental task. In it, he has assembled over 400 pages of data on sites on the World Wide Web of interest to radio amateurs. The sites range from the familiar, such as a mention of the RTTY Loop Home Page on page 269, through the exotic, such as the International Weather Satellite Imagery Center, which, for the record, bills itself as "The Internet's best source for weather satellite images" and can be found at [http://www.t-e.k12.pa.us/~dbaron/satellite/frindex.html].

Each site is not just listed, but an image of the first page is depicted, along with the complete URL, giving more of a cookbook feel to this work than just a directory listing. All of the listings in the book were obtained in the first few weeks of 1997, giving a real sense of timeliness to this work, something often lacking in the glossy directories for sale at your local computer or amateur radio store.

And just to keep everything up to date, Joerg maintains a web site were the book's URL links are all given, and can be updated. Of course, clicking on any of those links takes you right to the desired site. This has got to be the world's biggest links page!

Check it all out at [http://ourworld.compuserve.com/homepages/Klingenfuss] for this, and other fine radio publications, some of which have been mentioned here in RTTY Loop before.

AEA update

Thanks to Donovan P. Whitaker K8OMO, the *ARRL Letter*, and others who have passed along information about the turnover of AEA. As I mentioned a few months ago, AEA, the company which has been on the forefront of digital communications, closed its doors last year. Calling the situation "little orphan AEA," I alluded to the numerous times hams have been left out in the cold with equipment for which there was no support.

Well, while no Daddy Warbucks has appeared on the scene to rescue AEA, à la Annie, it appears that AEA will be selling its antennas, antenna analyzers and cable-testing equipment to Tempo Research of Vista, California. Continuing the AEA line as a separate division within Tempo, former chairman of AEA Mike Lamb will work in the marketing of this new line. There are plans to continue with new product development in the antenna line.

In another deal, Timewave Technology of St. Paul, Minnesota, is buying the rights to all other AEA products, including the digital so important to the RTTY crowd. Timewave president Randy Gawtry KØCBH has invited amateurs to check their Web site, at [http://www.timewave.com], for information on the transition from AEA to Timewave. The AEA name will remain in use for the first year of operation, with the model numbers continued indefinitely. They will handle technical support, in- and out-of- warranty service, and hope to continue new product development as well.

In the meantime, you can reach these companies by calling them at (619) 598-9677 for Tempo Research, or Timewave at (612) 452-5939. I know we all wish them both much success.

Stuff from y'all

Warren Bright dropped me the following via E-mail, the other day:

"I am not sure if you could be of any assistance. I have a friend who is deaf, and instead of using the TTY via an operator, I wondered if you would possibly have software, or know where I could obtain software, that would allow me to 'connect to,' or 'emulate' a TTY terminal using my computer and a Hayes-compatible modem. I have a 2400, and a 14.4k baud modem. If you could assist me in this matter, I would appreciate it very much.

"The only reason I am looking for such a product is that I do not like to use the operator-assisted TTY calls, and that I was told that there is software available to use my computer to talk directly to a TTY terminal."

Well, Warren, on the surface, since both TDD and RTTY use five-level Baudot/Murray code, at common speeds, it would seem that this could be a done deal. The sticking points would be the tone pairs used, whether telephone or AFSK type tones, and making sure the speed and bit patterns match. If the local telephone company office has a branch of the Telephone Pioneers club, they may be a great help to you, as the club here does a significant job with making TDD equipment available locally. Check it out, and let me know how you make out.

Richard M. Corrigan dropped me a note that read:

"Recently obtained an Info-Tech M-6000. Have a small manual and am really hooked. Do you know of any resources on the net or commercially available that will tell me more about this piece of gear?"

Well, Rich, I have asked about Info-Tech gear before, and come up empty; so here I go again. Can anyone supply Richard with info on this demodulator? Let him know, and tell me about it too. Thanks.

The last note this month comes from Julius Lewis KK4HW, who writes that he enjoys the material in RTTY Loop, and wonders where he can get some of the software we mention. Well, Julius, funny you should ask. As long-time readers of this column know, I have assembled a collection of programs of interest to RTTY hams on, currently, sixteen disks. The programs range from simple frequency lists to simple terminal programs to full featured packet and AMTOR programs and more, along with some

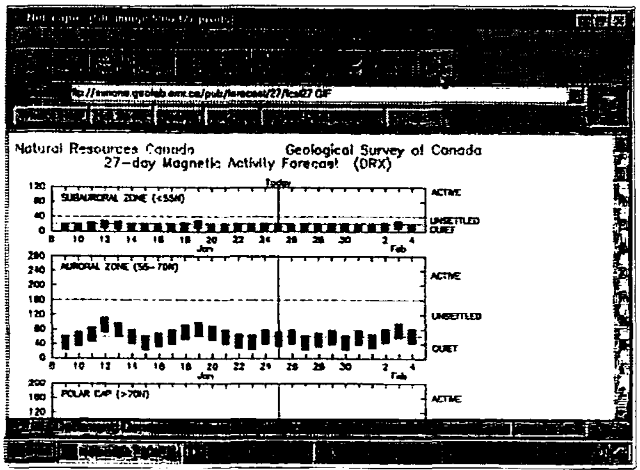


Fig. 1. Klingenfuss' 1997 guide has over 400 pages.

computer utilities thrown in. The whole listing is on line on the RTTY Loop Home Page, of course. If you have Web access, check it out at [http://www2.ari.net/ajr/rtty/]. Otherwise, send me a stamped self-addressed envelope, and I will send you a printed list of the disk contents. Each disk may be yours by sending me US $2, along with a blank disk and stamped disk mailer for each collection. As well, several of the programs are downloadable from the RTTY Loop Page; if it's a blue link, you can get it!

Believe it or not, this column closes out twenty years of RTTY Loop. Through the years I have thoroughly enjoyed your comments and questions. From the postcards and penciled notes of days gone by to the E-mail of today, it remains your input that helps shape this column, and take it into the directions that interest you. Write me at the post office box above, or E-mail me via the Web page or directly at[ajr@ari.net]. I look forward to your comments and questions as next month we begin the twenty-first year of RTTY Loop.

NEVER SAY DIE

Continued from page 70

from the Sonora (CA) *Union Democrat*. It was a nicely done article which I hope will nudge some people into the hobby. It mostly discussed our emergency communications services and didn't go much into the other benefits of the hobby—such as making it fun to learn about radio and electronics, the new group of friends you meet, and the fun of talking with people anywhere in the world.

If your local paper runs an article on hamming, please send me a copy. If they haven't run at least one article about hamming a month, then get yourself in gear and make it happen. Make sure that your club has a PR person and that this person is out there with a camera and laptop on Field Day, plus any other club activity. We need newspaper, radio and TV coverage in your town. None of this is going to happen unless you do it. And stop looking around for someone else to get moving. Yes, it takes motivation and initiative—well, you've got those in there somewhere, haven't you?

It's Too Late

Well, it's probably too late for you to be interested in work advice, but maybe you can help your kids or grandkids by cluing them in on how to beat the system. Almost no one does—it's a mighty powerful system, held in place by our school system and the media, which is run by products of the school system.

When we get out of school we're now "educated" and looking for a job so we can make money.

Will we settle for a job, or will we plan ahead and lay the foundation for a career?

A job will put food on the table next week. A career will keep it on the table for a lifetime.

Most jobs, no matter how boring, can be turned into learning experiences, and can lead to a career. Ask yourself, what are the possibilities if I get to be one of the best people in the world at the job I'm doing? Well?

If you were to read books and subscribe to magazines on the subject, or take classes—if you were to attend seminars, network with other people doing similar work, could you get good enough at what you're doing to write about it and teach others what you've learned? Maybe start a newsletter? Are there ways to use new technologies (like computers, closed circuit TV, pagers) to improve what you're doing?

Of course, if you haven't bothered to keep up with new technologies, then you aren't going to see ways to adapt them to your work.

You know, I've had over a thousand employees over the years, but I can't think of one who ever pestered me to learn more about his work. Oh, I tried to get 'em interested in reading relevant books and magazines so they'd be more productive—so they'd be of more value to me and themselves. I've attended some wonderful lectures and made tapes of them available. I never was able to get anyone interested enough in building their skills to listen to the tapes or read a book.

And that's a shame, because the world is wide open to anyone willing to make the effort to learn. Somehow the idea seems to have been firmly implanted by our blessed school system in just about every mind that once you're out of school you don't have to waste any more time learning stuff. You're now educated. Period. And never mind that around 99% of the "learned" stuff has been long forgotten. Or that less than 10^{-3} of it will ever be relevant to your work.

Hmm, let me modify that open world claim. That doesn't hold for certain types of semi-dead end jobs—such as working for a large corporation. Or for government jobs. Or teaching. All proven ways to never score big in the world. No, my advice is aimed at helping people to make a real life for themselves while working for a smaller company. Almost any kind of smaller company.

Of course, if you prefer the security of the office-politics hive-type life in a large corporation you still can benefit from doing your homework. But you'll get more benefit from books like *The Dilbert Principle* by Scott Adams. Look busy, keep your head down, and wait for retirement. Then die. Or get downsized or outsourced, and wonder what happened!

Now that I've read a stack of books on our school system, I see school as a way to spend twelve years on what can be learned in a couple, and with only a tiny fraction of it relevant or of any long-term benefit to you. College? Well, I suppose we have to have some physicists and economists. Hmm, I wonder who hires 'em? Other colleges, I'll bet. Well, once tenured, it's not a bad life. A couple hours a week (or less) of actual teaching. A good retirement program when you're too old to get much benefit from it. Most of it is publish or perish, parsing minutiae. The pay is adequate, though the standard of living required strains it.

I just wanted to get you thinking, not turn this into a handbook.

Secrets

Several of the exposé shows that *60 Minutes* has spawned have had recent segments interviewing survivors and the children of those involved with the Roswell "incident." One chap was a supply sergeant who cited the records he made at the time on the cost of flying in a special cargo plane to take away the debris that had been collected. He talked about the room where they kept the alien corpses, and the large number of troops sent to scour the crash site for debris. Weather balloon, eh? Sure. The children of local residents all claim that the military threatened them with the death of them and their entire family if they didn't keep everything a secret.

Now, re the moon. The government cover-up at Roswell and threats have had a consistent pattern which makes them difficult to ignore. The amazing thing is that the government has been able to keep the story buried for almost 50 years.

But then, as I've written several times, and gone into some detail in my WWII submarine adventures book, the government is still actively covering up the Amelia Earhart story. Through serendipity I happened to know about her spy mission before her flight. Her mechanic, Bob Wemple, was a good friend of my father's and he told us the whole story one night when he was visiting for dinner.

My father was an aviation pioneer. He went around the country, compiling the first book on American airports for the Department of Commerce back in the 1920s. He had pilot's license #73 and commercial pilot's license #89. I remember as a kid our going to air shows where he would check out all of the planes before the show by taking them up for a quick flight. I suspect he has the record for the most different kinds of planes flown by one man in one day.

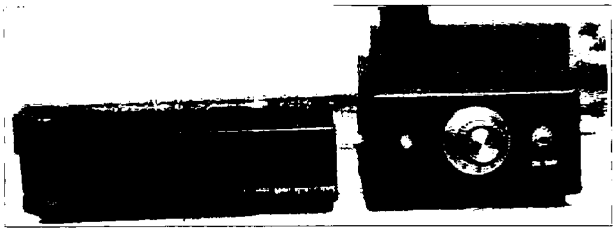
In the late '20s he designed, built and managed Central Airport, the main airport for Philadelphia. This is where Amelia kept her Lockheed, which I used to climb all over as a kid. She,

Continued on page 83

Number 80 on your Feedback card

New Products

Get Excited!



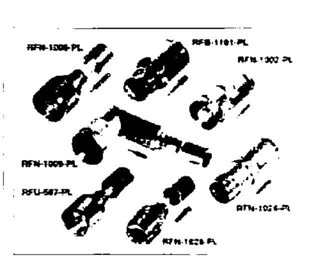
Pauldon Associates has a nifty hyperband video modulator for ATV operation on the 70cm band—compact, sturdy, and handy to use. The hyperband exciters from Pauldon start at $125 and have a front digital display to indicate the channel in use. Pauldon Associates also makes companion power amplifiers—the one shown here is the PD-440NA, with switch and indicator light on the front panel. The PD-440NA and its sibling, the PD-440NB, are both available with T/R switching. If you get the power amplifier and the exciter together they're $338 (without T/R switching, $288), and you'll have the power you need for sharp, brilliantly-colored video and clear audio. For more information, contact Don Fuller W2WHK at Pauldon Associates: 210 Utica St., Tonawanda NY 14150; phone or FAX (716) 692-5451.

"Island" Memories

No, not vacation slides from Jamaica. It's the WB9KZY "Island" Memory Keyer kit, and Milestone Technologies is delighted to offer it complete for only $21.95 (+$3 s&h). The thing is so tiny (1.5 x 2") you have to see it to believe it—you can mount one of these inside the smallest QRP transceiver. It has four separate memories, a straight-key input, a sidetone oscillator, and speeds from seven to 48 wpm.

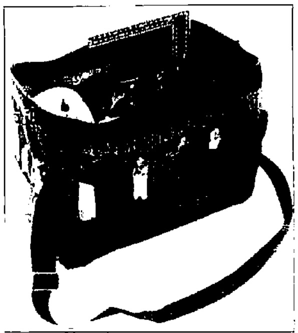
The Island Keyer kit includes the circuit board and all board-mounted components—anything else you need is readily available at your neighborhood you-know-what. For an additional $12, you can get the hardware, too! If you order the kit *and* the hardware, you pay only one shipping & handling fee. Send check or money order to: Milestone Technologies, Inc., 3140 S. Peoria St. Unit K-156, Aurora CO 80014-3155. Call toll-free (800) 238-8205 for credit card orders; for more information, call (303) 752-3382.

Make New Connections



RF Connectors, a division of RF Industries, has released several BNC, N, and UHF connectors designed for use with RG-8U cable, which, as every ham knows, is as ubiquitous as duct tape. These shiny new connectors will liven things up, so see your RF Connectors distributor, call (800) 233-1723 or E-mail [102061.2261@compuserve.com].

Grand Opening!



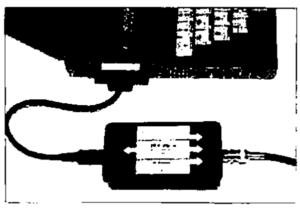
The name says it all—Paktek's latest addition to their Toolpak® line is the ProTote™, offering you Grand Opening™: wide-open, one-zipper access to your tools and supplies. Just about whatever you need to carry fits in the 12 outside or 16 inside pockets, and the ruggedly built ProTote handles most conditions. It's made of waterproof fabric, has a rigid bottom for stability, padded handles, and D-rings for attaching the optional shoulder strap or other necessary items. Order ProTotes from Paktek, Inc., 7307 82nd Street Court, Tacoma WA 98498. Phone (206) 584-4914; FAX (206) 589-1091, or visit the Web site at [www.toolpak.com].

Shack Attack!

No, this is a *good* thing. It's a catalog from some ham folks in Utah (P.O. Box 91, Enterprise UT 84725). There's stuff to buy, stuff to chuckle over, a project, and a real good attitude. They're featuring a new item, the "Ham Gallery." Display your QSL or favorite ham photo in this sturdy acrylic easel frame, with your call custom laser-etched across the bottom.

Get your copy of the catalog *now*. Write Shack Attack at the P.O. box; FAX (801) 878-2100; call (801) 878-2760; E-mail [kb7vrd@aol.com] or check out their Web site at [www.vcnet.com/sa]. Just get your own. This one's *mine*.

OFS WeatherFAX's Viking



The Viking is a high-performance computer-controlled synthesized VHF satellite receiver—in a miniature low-cost ($445 with software) unit made for use in harsh mobile, portable and base station environments. It works with the companion PC Card (PCMCIA) satellite decoder, allowing satellite technology to be used with laptops and desktops, bringing it wherever it's needed. Fishermen, teachers, pilots, and anybody else who needs weather information *right now, right here*, rejoice!

There's nothing to adjust—all options are set using the Viking software. It's only slightly larger than a deck of cards, in a rugged case, and since it's powered by the computer, you don't need an external power source! It could save your life... or maybe your camping trip... so check it out at your dealer or by phone/FAX at (919) 847-4545; E-mail at [jdahl@worldnet.att.net].

Special Events

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the October issue, we should receive it by July 1. Provide a clear, concise summary of the essential details about your Special Event.

ANNOUNCEMENT

FRIENDSHIP, WI Due to circumstances beyond control, the Adams County ARC '97 Hamfest scheduled for June 1, 1997, has been cancelled. Plans are already in place to hold a much larger and expanded hamfest on June 7th of next year.

JUN 1

GRAND RAPIDS, MI The annual IRA Hamfestival will be held at Hudsonville Fairgrounds near Grand Rapids. Doors open at 8 AM for general adm. Dealers can set up on the 6th after 7 AM , or after 6:30 AM on the 7th. Overnight camping. Bring your equip., etc., to sell and trade. VE exams at 8:30 AM. Talk-in on 147.16 link rptr system. Reserve early for the best spots. Indoor table space and trunk sales spaces available. Contact the *IRA voice mail/info line* at *(616) 534-6803;* or *Tom KA8YSM,* or *Kathy KB8KZH,* at *(616) 698-6627.*

NEWINGTON, CT The Newington Amateur Radio League will hold its annual Ham Radio Flea Market at Newington H.S., Rte. 173, from 9 AM–1 PM. Dealer setup is at 8 AM. Tailgating, refreshments. Tables are $15 in advance (make check payable to *NARL* and send with an SASE to *Ed Matthews KC1JV, 69 Wildemere Ave., Waterbury CT 06705).* Tables are $20 at the door. Adm. $4. VE exams at 10 AM by pre-reg. only, to *Paul Sheldon N1LJA, 1509 Summer Hill Dr., S. Windsor CT 06074. Tel. (860) 875-6246.* For general info, call *Fred Jarvis N1KWJ, (860) 666-1952.*

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St. Vendor setup at 7:30 AM; buyers admitted at 9 AM. Free parking. Adm., buyers $5, sellers $10 per space. Talk-in on 444.200 WB2ZZO rptr, and 146.52 simplex. For more info, call, eves. only, *Amie Schiffman WB2YXB, (718) 343-0172.*

TEANECK, NJ The Bergen ARA will hold its annual Spring Hamfest at Fairleigh Dickinson Univ. Buyer adm. $3, with XYLs and harmonics free. Seller adm. $10. VE exams. Talk-in on 146.790/.600. Contact *Jim Joyce K2ZO at (201) 664-6725 before 10 PM.*

JUNE 7

LEMPSTER, NH The Connecticut Valley FM Assn. will hold their 7th Annual Hamfest, 8 AM-3 PM, at Goshen-Lempster Coop. School. Rt. 10, 10 mi S of Newport NH, 25 mi. N of Keene NH. VE exams and demos will be featured. Adm. $1. Table/space $6, includes 1 adm. Talk-in on 146.76. Contact *Conrad Ekstrom WB1GXM, P.O. Box 1076, Claremont NH 03743. Tel. (603) 543-1389. E-mail: [goshlem @srnet.com].*

JUN 8

CHARLOTTE, NC The 5th Annual Charlotte ARC Hamfest & Computer Fair will be held Sunday, June 8th, at the Roll-A-Round Skating Center, 8830 East Harris Blvd., 8 AM-4 PM. This is an ARRL-sanctioned hamfest. There will be computer and radio dealers as well as about 200 flea market tables. Limited tailgating. Flea market setup is 6 AM-8 AM. Adm. $4 in advance, $5 at the door. Children 12 and under are admitted free. Tailgating is $5 per space. Adm. tickets are included with the purchase of 2 or more spaces, and are available for $2 for tailgaters requesting only one space. The selling or solicitation of pornographic-type material is prohibited within the indoor or tailgating areas. Flea market tables are $8 in advance, $10 at the door. Chairs are $1 ea. Pre-reg. requests should be sent with an SASE to *Charlotte ARC, P.O. Box 33582, Charlotte NC 28233-3582.*

ERLANGER, KY The Northern Kentucky ARC will hold "Ham-O-Rama '97" at the Erlanger KY Lions' Park. Prizes and forums. ARRL-sanctioned. Indoor exhibit area for major vendors. Extensive outside flea market with setup at 6 AM. General admission begins at 8 AM. Adm. $4 *in advance,* $5 at the gate. Children under 13 admitted free. Flea market spaces $2 each (with purchase of gate ticket). Bring your own table and chair. Indoor vendor spaces $15 per table (provided) and one gate admission. Location: Erlanger Lions' Park, I-75 to Exit 184 (Rte. 236 East). Go one mile to Dixie Hwy (U.S. Rte. 25 & 42). Turn right and go one mile to Sunset Ave. Right on Sunset to end of street. For more info or advance registration, contact *N8JMV, c/o NKARC, P.O. Box 1062, Covington KY 41012;* or call *(513) 797-7252 eves.* Talk-in on 147.255(+) or 147.375(+) rptrs.

WHEATON, IL The Six Meter Club of Chicago, Inc., will hold their 40th Annual Hamfest at the Du Page County Fairgrounds, 2015 Manchester Rd. [N of Roosevelt Rd. (Rte. 38), E of County Farm Rd.], rain or shine. Advance tickets $4 for everyone over age 12; $5 at the gate. Advance tickets are available from *Joseph Gutwein WA9RIJ, 7109 Blackburn Ave., Downers Grove IL 60516,* or from any club member. Commercial tables (8 ft. w/110 V) main bldg. air cond.. $15 ea.; indoor flea market tables, 8 ft., no electric, $10 ea. Limited overnight RV parking (includes elec. hookup), $10 ea., advance registration required. General parking at the west gate, sellers only at the east gate. Gates open at 7 AM. Indoor setup for pre-registrants is at 7 AM. Buildings open to the public at 8 AM. Talk-in on K9ONA 146.52 and K9ONA/R 146.37/.97 (107.2). Absolutely no alcoholic beverages permitted. VE Exams, all elements, 9 AM-1 PM. For more info, call the *24-hour InfoLine at (708) 442-4961.*

JUN 12 & 26

FORT WORTH, TX The Lockheed ARC and the Kilocycle Club of Ft. Worth are sponsoring test sessions for all license classes. They will be held at the Lockheed Rec. Area Facility, 2400 Bryant Irvin Rd., Ft. Worth TX, at 7 PM. For details call *Ted Richard AB5QU, (817) 293-6745.* G.R.O.L. testing done by appointment only.

JUN 13-14

ALBANY, GA The ARRL Georgia Section Convention (15th Annual Albany Hamfest and Computer Fair) will be held at the Albany James H. Gray, Sr., Civic Center. Doors open to the public Fri., 5-9 PM and on Sat., 9 AM-4 PM. Features include VE exams Fri. at 6 PM, outdoor flea market Sat. only ($10), forums and free parking. Talk-in on 146.82. Adm. $5 at the door. Contact *Arthur Shipley N4GPJ, c/o AARC, P.O. Box 70601, Albany GA 31708-0601. Tel. (912) 439-7055.*

JUN 13-15

RED DEER, ALBERTA, CANADA The Central Alberta Radio League will host its 27th Annual Picnic and Hamfest at the Burbank Campsite located approx. 8 km NE of Red Deer. Talk-in on 147.150(+600) or 146.520 simplex. For info, contact *Bob VE6BLD, 5540 54th Ave., Lacombe, Alberta, Canada T4L 1L6. Tel. (403) 782-3438 eves. FAX: (403) 782-3438. Packet: [VE6BLD @VE6RDR.AB.CA].* Or call *Janet VE6JGM at (403) 340-3498; packet: [VE6JGM@VE6RDR.AB.CA].*

JUN 14

BANGOR, ME The Bangor Hamfest will be hosted at Hermon H.S., 0800 hrs.-1300 hrs. by the Pine State ARC. Travel on I-95 to exit 44 (Cold Brook Rd.) to US #2. US #2 west 1 mi. to the high school. From the village, take US #2 east 1/2 mi. to the school. Tailgaters, dealers, VE exams for all classes, hamfest, ARRL and section forum. Rain or shine. Adm. $3 per person, under 12 free. Talk-in on 146.34/.94 and 146.52. Tables are $8 ea. Demonstrations feature frequency calibration, QSL card displays, old ham gear, key collections, home-brew equip., Hermon new type 3 ambulance, Zoll defibrillator, free blood pressure check. There are campgrounds and many motels within 5 miles. Contact *Roger W. Dole, RR #2, Box 730, Bangor ME 04401. Tel. (207) 848-3846.*

MIDLAND, MI The 22nd Annual Hamfest of the Midland ARC will be held Sat., June 14th at Midland County Fairgrounds 8 AM–1 PM. Set up at 6:30 AM. Admission is $4, advance reserved tables $6 ea., trunk sale space $5. Featuring amateur radio, personal computers, new and used equipment, trunk sales, VE exams, software, coax, etc. Talk-in on 147.00(+), Midland. For more info, write *MARC Hamfest, P.O. Box 1049, Midland MI 48641.* Please SASE, or call evenings or weekends, *(517) 839-9371 or (517) 496-2999.*

PADUCAH, KY The Paducah ARA is pleased to *announce* that the 1997 "Dukefest" will be held Sat.,

June 14th, at the Executive Inn Convention Center 9 AM–3 PM. Free parking. VE exams will be held at 1 PM. Adm. $5, tables $6, with one free ticket per vendor. Contact *Craig Martindale WA4WBU, 2509 Trimble St., Paducah KY 42001. Tel. (502) 444-6822* or *(502) 443-3860*. E-mail: *[KC4ENA@APEX.Net]*.

JUN 15

BLUEFIELD, WV The Bluefield Hamfest will be held 9 AM-3 PM at the Brushfork Armory on US 52, one mi. north of Bluefield. VE exams at 9 AM at Bluefield State College, 1 mi. south of the hamfest. Walk-ins accepted. Hamfest adm. $5, senior citizens $4, children under 12 free. Tables $5 ea. Inside flea market and dealers. Paved parking and wheelchair access. Talk-in on 145.49 (BR549) rptr. For more info, send SASE to *Bluefield Hamfest, Inc., 412 Ridgeway Dr., Bluefield VA 24605-1630*, or E-mail: *[wa4k@amsat.org]*. Dealers contact *Bob Frazier WB8NRK at (304) 425-8464*, or E-mail: *[cna00188@mail.wvnet.edu]*. See our Web site at *[www.inetone.net/erarc/hamfest.html]*.

CAMBRIDGE, MA The MIT Electronics Research Soc., the MIT Radio Soc., and the Harvard Wireless Club will be holding a tailgate electronics, computer and amateur radio Flea Market Sunday June 15th, 9 AM-2 PM, at Albany and Main Streets. Adm. $4. Free off-street parking. Sellers $10 per space at the gate, $9 in advance (includes 1 adm.) Set up at 7 AM. For space reservations or info call *(617) 253-3776*. Mail advance reservations before June 5th to *W1GSL, P.O. Box 397082 MIT BR, Cambridge MA 02139-7082*. Covered tailgate area available for all sellers, rain or shine. Talk-in on 146.52 and 449.725/444.725 pi 2A W1XM/rptr.

CROWN POINT, IN The annual "Dad's Day" Hamfest, sponsored by the Lake County ARC, will be held at the Lake County Fairgrounds, Crown Point IN. Talk-in on 147.00, 146.52 and 442.075. This year there will also be computers, software and hardware vendors. Setup at 6 AM. Doors open to the public at 8 AM. Adm. is $5 per person; tables $6 ea. Contact *Malcolm Lunsford WN9L* for reservations, *Callbook* address, or *[72202.230@compuserve.com]*.

JUN 21

DUNELLEN, NJ The Raritan Valley Radio Club's "97 Hamfest" will be held at Columbia Park, near the intersection of Routes 529 and 28. Sellers 6 AM, buyers 7 AM-2 PM. Admission $5 for buyers, sellers $10 ($5 each additional space). Talk-in on 146.625(r), 447.250(r), tone 141.3, 146.520(s). Contact *Bob Pearson WB2CVL, (908) 846-2056 [RWPEARSON-WB2CVL@WORLDNET.ATT.NET]*, or *John Manna WA2F, (908) 722-9045*. To pre-register, contact *Chuck Fainsbert KC2NB, (908) 873-2198*, or E-mail: *[FAINSBERT@WORLDNET.ATT.NET]*. Please call before 8 PM.

MARMORA, ONTARIO, CANADA The Tri-County ARC and the Northumberland ARA will co-sponsor the 1997 Eastern Ontario Hamfest & Computer Flea-Market at Marmora Area Curling Club on Crawford Drive. Adm. $3, children under 12 free. Tables $10, one admission included per table. Tailgaters $6. The event will be open 9 AM–2 PM, with vendor setup at 7 AM. Contact *Pete VA3PGB at (613) 473-1171*, or *Richard VE3BZY at (613) 473-2665*. The E-mail address is *[rhobson@blvl.igs.net]*. The Web site is *[www.redden.on.ca/home/~hamfest/index.html]*. Paul VE3UUM will take packet messages at *[ve3uum@ve3hqr.#econ.on.can.na]*.

JUL 4

DILLSBURG, PA The Harrisburg ARC will hold its Firecracker Hamfest 8 AM–2 PM at the Monagahan Fire Hall, 245 W. Siddonsburg Rd., Dillsburg PA. VE exams start at 9 AM. Talk-in on 146.16/.76 MHz. For info and table reservations phone the *HRAC AnswerLine at (717) 232-6087*.

JUL 5

SALISBURY, NC The North Carolina Alligators Group "Firecracker Hamfest" will be held at the Salisbury Civic Center, 8 AM–1 PM. Admission is $3 in advance (with an SASE), or $4 at the door. Free to XYLs. Auction of goods will be at 1 PM. Dealer setup at 6 AM. Tables in the air conditioned center are $5. Outside flea market spaces are free. Contact *Walter (Alligator) Bastow N4KVF, 3045 High Rock Rd., Gold Hill NC 28071*. Talk-in on 146.625. Directions: From I-85, take Hwy. #52 West/East Innes St., turn left on South Boundary St. The hamfest is on the left.

JUL 12

OAK CREEK, WI The South Milwaukee ARC, Inc., will hold its annual "Swapfest" on Sat., July 12th, at the American Legion Post #434 grounds, 9327 S. Shepard Ave., 7 AM until at least 2 PM CDT. Free parking, picnic area, and free overnight camping are available. Admission, $5 per person includes "Happy Time" with free refreshments. Free flyer by writing to *The South Milwaukee ARC, Inc., P.O. Box 102, South Milwaukee WI 53172-0102. Tel. (414) 762-3235*. Talk-in will be on 146.52 simplex as well as on many of the local repeaters.

PETOSKEY, MI The Straits Area ARC will host a Swap & Shop in the 4-H Bldg. at the Emmet County Fairgrounds. Talk-in on 146.68(-) and 146.52. Contact *Jim KC8FFS at (616) 537-2422* for details. For VE exam info, call *Floyd KG8CS at (616) 526-5503*.

JUL 12-13

INDIANAPOLIS, IN The Indianapolis Hamfest will host the ARRL Central Division Convention as well as feature huge ham, computer, and electronics show. Marion County Fairgrounds, easy access from I-465 and I-74. Commercial exhibits, flea markets, forums, banquet, overnight camping available, homebrew contest, T-hunts, prizes, more. Write or call *Indianapolis Hamfest Association, P.O. Box 88677, Indianapolis IN 46208; tel. (317) 251-4407; [www.indyhamfest.com]*.

SPECIAL EVENT STATIONS

MAY 31–JUN 1

HOUSTON, TX The Clear Lake ARC will operate K5HOU, or their own calls, 0000 UTC May 31st–2300 UTC Jun 1st. The event will be the 3rd annual "Hurricane Party," marking the beginning of hurricane season in the Gulf of Mexico, and promoting Hurricane Awareness. Operation will be on the General portions of the HF bands, plus KA5GLX rptr. at 442.75 MHz, tone 103.5. For a certificate, send QSL and a 9" x 12" SASE to the station worked.

JUN 7

ST. CLOUD, MN The St. Cloud ARC will operate WØSV/75 to commemorate the club's 75th Anniversary, from 0000Z–2359Z. Freqs.: CW—28175, 21175, 14075, 7125, 3700, and 1875; SSB—28375, 21375, 14275, 7272, 3875, and 1975. QSL and certificate can be obtained by sending a 9" x 12" SASE to *WØSV, St. Cloud ARC, 401 4th Street N., Waite Park MN 56387*.

JUN 7–8

BOWLING GREEN, KY Station KB4ALC will be operated 0000 UTC Jun. 7th–2400 UTC Jun. 8th, by the Western Kentucky DX Assn., in celebration of the 1997 Corvette Homecoming. Operation will be on 3.860, 7.235, 14.235 and 21.310 MHz. A special certificate is available from *Kenneth E. Newman KB4ALC, 505 Emmett Dr., Bowling Green KY 42101*.

JUN 14

FULTON, NY The Oswego County Amateur Radio Emergency Service, Fulton ARC, and Experimental Aircraft Assn., Chapter 486, will operate KY2F 1200Z–2100Z from the Oswego County Airport in conjunction with Young Eagles Day. Operation will be in the lower half of the General 80, 40, 20, 15 and 10 meter phone bands. For a certificate, send your QSL card and a large SASE to *KY2F, Box 5281, Oswego NY 13126*.

JUN 14-15

STEUBENVILLE OH The Weirton (WV) ARC will operate W8CWO, 1500Z–2200Z Jun. 14th, and 1500Z–2200Z Jun. 15th, to celebrate the Fort Steuben Bicentennial. Listen for them on 7270, 14270 and 28470 MHz. For a certificate, SASE to *Bill Leist WA8DRL, 2444 Alexander Manor East, Steubenville OH 43952*.

JUN 21–22

VANCOUVER, WA The Clark County ARC will operate special event station W7AIA 1600Z–2400Z June 21st and 22nd, to celebrate the grand reopening of Pearson Air Museum, and the 60th anniversary of the Russian Transpolar Flight. Activity will be on the General phone subbands at 80, 40, 20, and 15 meters, and Novice/Tech phone subband on 10 meters. To obtain a certificate, send a #10 (business-size) SASE to *CCARC, 4211 NE 140th Ave., Vancouver, WA 98682*.

WELLSBORO, PA The Tioga County ARC will operate WQ3C

1400Z June 21st–1800Z June 22nd, in commemoration of Amateur Radio Awareness. Operation will be on 3.860, 7.250, 14.250 and 28.375 MHz. A special QSL card and certificate are available. Write to *Darlene Rahn, RR #6 Box 200, Wellsboro PA 16901-8972.*

JUN 26

SAN BERNARDINO, CA The Citrus Belt ARC plans to operate W6JBT, 1600Z–0400Z, to commemorate the 50th Anniversary of the Citrus Belt ARC. W6JBT will operate SSB on 3.850, 7.240, 14.250, 21.350; CW on random frequencies, 2m phone and 2m packet. For a certificate, send QSL and a 9" x 12" SASE to *W6JBT, P.O. Box 3788, San Bernardino CA 92413.*

JUL 3-5

NEAR ROSWELL, NM An Amateur Radio Special Event Station will operate 1700 UTC–2400 UTC, daily, July 3rd, 4th, and 5th, to celebrate the 50th anniversary of the "Crash at Corona" near Roswell NM. Frequencies: Approximately 20 kHz up from the bottom edge of the General HF band edge, 6–40 meters (phone and SSB), and in the Novice/Technician (CW) HF section of 15 and 40 meters. Listen for W5BI, WB5LYJ, NA5N and WA5WHN. The station will operate overlooking one of the debris fields near Corona NM. SWL reports are encouraged, too. SASE required. Send a 9" x 12" SASE and 2 units of US first class postage, along with your QSL card to *Jay Miller WA5WHN, P.O. Box 6552, Albuquerque NM 87197-6552.* Check the W5BI Web page *[http://www.flash.net/~w5bi/]* for further developments, or E-mail: *[wa5whn@juno.com].*

NEVER SAY DIE

Continued from page 79

and many other aviation pioneers, used to come over for dinner at our house.

Anyway, the government is better than many of us think at keeping secrets. Look at the job they did with the atom bomb project!

Even so, I'm as resistant as most of you to conspiracy theories. Hey, we have all kinds of kooks out there. This is being proved every day, so it's normal to tend to be skeptical of strange stories with little supporting data. As a known troublemaker I'm deluged with more of this kind of stuff than most other people from groups seeking legitimacy. The hollow earth, N-machines, zero-point energy, and on. And on.

It's even worse in the alternative health field, where charlatans and the naive are making money by selling stuff to desperate people. But I read all I can, and look for claims that make sense, and can be supported by more than testimonials.

As I've mentioned a few times, when René sent me his *NASA Mooned America* book I sighed. Obviously another kook. But I dutifully sat down and started reading it. Hmm. As René made one scientifically valid point after another, all pointing to the impossibility of the Apollo moon trips' being real, I shared my thoughts with you and made arrangements to make René's book available. If I couldn't find holes in his reasoning, perhaps others could show me where he'd made mistakes.

So here we are with several hundred copies of the book having been read by people trying to poke holes in the admittedly preposterous idea that NASA, with the help of the CIA, has perpetrated a $4 billion fraud. The mail I've been getting from people who've read the book all indicate a reluctant agreement that René is right. Further, I've had several letters from readers who had their own good reasons for doubting the moon missions, but were afraid to say anything.

Oh yes, on the Earhart thing, I see that a woman is duplicating Amelia's last flight. But I'll bet her Lockheed Electra isn't equipped with the more powerful engines, extra wing tanks and cameras like Bob Wemple built into Amelia's plane so she could overfly Truk and get photos of the secret Japanese base there on her way from Lea, New Guinea to Howland Island.

Fried Brains

Old Worry-Wart Wayne and his EMF alarums is at it again. Yes, I know the power companies are spending what it takes to buy scientific proof that their magnetic fields are harmless, and that most of you dutifully swallow their testimony—though you do cast an apprehensive eye at those overhead power lines. Maybe—who knows, right?

Well, you haven't done your homework and I have. For instance, Dr. Peter French, one of Australia's top cell biologists, ran a test with brain cells which he irradiated with mobile phone RF for 10 minutes a day for a week. The result was a reduction of the proteins in the cells by as much as 70%, and he found that this damage was not repaired, even after many cell generations. Permanent damage to the brain cells. Is that what you want? If you must use a cell phone I suggest you use one of those cheap bag jobs and mag-mount the antenna on top of the car. Ditto your 2m HT—run coax to a roof mount antenna. Hey, by the time you've been through the American school system and a couple of decades of TV watching, you don't have a lot of brain left still functioning, so you can't afford to zap what's left with an HT or cell phone.

Diehards

Putting issue #21 of *Cold Fusion* together got me to thinking. Between the resistance of most scientists to anything they weren't taught in school and the rightful resistance to change of the power generation and distribution industry, it's not difficult to understand why cold fusion as a new non-polluting and inexpensive energy source is being either ignored or fought.

Early researchers ran into problems of reproducibility. Some groups sometimes were getting the excess heat that Pons and Fleischmann had claimed. Detractors quickly leaped to pooh-pooh the whole thing as sloppy laboratory work and calorimetry errors.

It turns out that once researchers started using thin films or powdered metal, where there was a large surface area for the reaction, some stupendous amounts of excess heat and dependable reproducibility resulted.

So where's all this heat coming from? You don't get something for nothing, despite the dreams of the zero-point energy enthusiasts. It's gotta come from somewhere.

The answer turned out to be fairly simple, though wading through the pages of equations proving it is not for the timid. There's a marvelous little book by Michio Kushi, *The Philosopher's Stone*—ten bucks from One Peaceful World Press, Box 10, Becket MA 01223. Kushi proves how simple it is to commit alchemy on the kitchen table. And he shows the chemistry to back it up.

That's right, the cold fusion phenomenon depends on the transmutation of elements for its excess heat. A Japanese group, led by Hideo Kozima, has been taking the experimental results from research groups all around the world and explaining the physics of what's been happening with their Trapped Neutron Catalyzed Fusion (TNCF) theory. While the math proving the validity of the concept may be complex and riddled with Greek letters, the basic idea is fairly simple.

The cold fusion effect works with metals which have a lattice-like structure, one in which hydrogen can be absorbed. Then, when you pass an electric current through the lattice which is packed with hydrogen, some of the neutrons trapped in this restricted area combine with the metal and electrolyte atoms to make elements of a higher atomic weight. In some cases there is a slight amount of mass lost in the transmutation. If you check the atomic weights on the periodic table of elements you'll see what I mean. Einstein's equation, $E = mc^2$, explains it. By the time you multiply even a small mass by the square of

Continued on page 87

Number 84 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

As the summer hamfest season begins in earnest, here's a tip to keep in mind: Computer power supplies, the switching supplies used to provide 5 and 12 volts DC for the motherboard inside the average desktop computer, seem to abound at hamfests and computer swapmeets these days. The supplies are usually rated at anywhere from 150 to 300 watts output and will supply 5 volts DC at about 15 to 20 amps and 12 volts DC at 6 to 15 amps. Don't overlook their possibilities as a compact, lightweight alternative voltage source for your 12-volt DC ham gear. They'll quite likely supply the necessary current to power a VHF or UHF ham transceiver, medium power "brick" amplifier or several components needed to complete a packet node or PBBS station...often at next-to-giveaway prices!

I recently came upon a couple of these supplies that had been used in older, bulkier IBM AT PC cases, the other parts of which had been transferred to newer, smaller-profile cases. Although one has to be careful in using switching power supplies around radio equipment (they can generate quite a bit of RFI and desensitize a transceiver's front end), most of the better supplies are pretty well shielded and RFI-proofed. It helps if you eliminate all of the unused output leads (of which there are often many) by cutting them off, taping up the ends and turning them back inside the case. Only those supplying 12 volts DC and ground are needed. Now the supply can be checked out with a hand-held transceiver (preferably on the same band as the equipment to be powered will be operating) by using the handheld's rubber duck antenna as a probe. If there is still some noticeable RFI from the power supply, it's often possible to further reduce it to acceptable levels by using a shielded primary AC power cord, and by installing ferrite beads on the output DC leads, just before they exit the supply's case (or by passing the leads through a toroid core a couple of times on their way out). Sometimes, just keeping a bit of distance between the supply and the radio itself is all that's needed. If the radio is being fed from an external antenna via well shielded coax, then the chances of successfully using a "recycled" computer switching supply are even better. The main point here is not to overlook the possibility of using these supplies as compact, lightweight bench and RF equipment alternative power sources just because they were made for computer service.

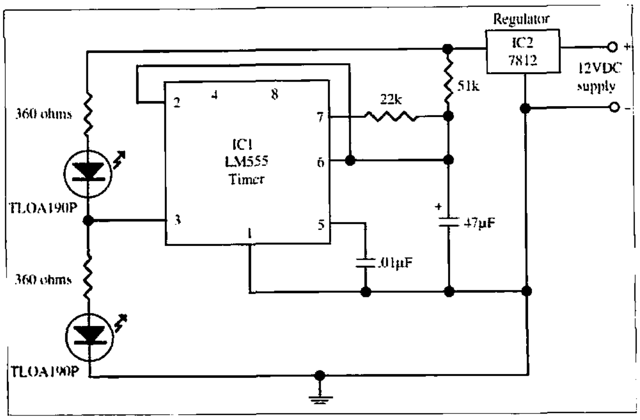


Fig. 2. N4UAU's "winking" pumpkin eyes. LEDs D1 and D2 will alternately be lit for approximately one-second intervals.

A bright spot at last!

From Sam Ulbing N4UAU: "After reading Frank Brumbaugh's article titled 'A Low Current Light' (*73 Amateur Radio Today*, November 1996), here's an expansion (and perhaps a different twist) that I've uncovered. For over a year now I've also been using an LED as the main element in a 'non-night-blinding-flashlight' for my sailboat. The particular LED I use is somewhat unusual, and if anyone else might be planning to build a low-current, easily portable flashlight, I'd recommend something like this one.

"The LED I'm using is a Toshiba TLOA190P(WX) (available from Hosfelt Electronics), but what makes it unusual is that it's rated at 18,000 to 36,000 mcd. That's a lot of mcds when you consider that the average LED is somewhere in the range of 10 mcd, and the so-called 'Super Ultra Bright' jobs are about 3,000 mcd. This baby is bright!

"The color of the TLOA190P (WX) is described as orange in the catalog, but I'd call it red. While Frank brought up the point that red attracts insects, I've found it to be an ideal color out on the water, because it doesn't cause night-blindness as other colors might. This is a very real concern to a night-sailor, and perhaps to others who are involved in pursuits where maximum retention of night-vision is an important factor to consider (campers, drivers, pilots, security and police officers, etc.).

"I'm using the TLOA190P(WX) LED as a low power light source in several ways. I've outlined some examples below:

• I have two AA alkalines, a small slide switch and 20Ω resistor all taped together (I'm not what you might term a 'case-building expert'). The switch and LED fit nicely along the side of a two-cell AA battery pack, and the package is simply wrapped in electrical tape. It's small enough (2.75" by 1.75" by .75"), and it's the flashlight of choice that I carry with me on my sailboat. I can illuminate up to the tip of my masthead, some 55 feet up from the deck, and check on the wind telltales with this little beauty... that takes a bright light! With a 20Ω current limiting resistor, current drain is only about 30mA from the 2,000+ mAh available from good quality alkaline AA batteries; that equates to better than 65 hours of continuous use!

• I've also built a small LED flashlight onto a floating key-chain, using a single-cell 3V lithium battery and a combination of a slide switch and a mercury switch as the activation devices. When I'm on the dock at night I'll turn on the slide switch, and if I accidentally drop the keys into the water, they'll float upside down

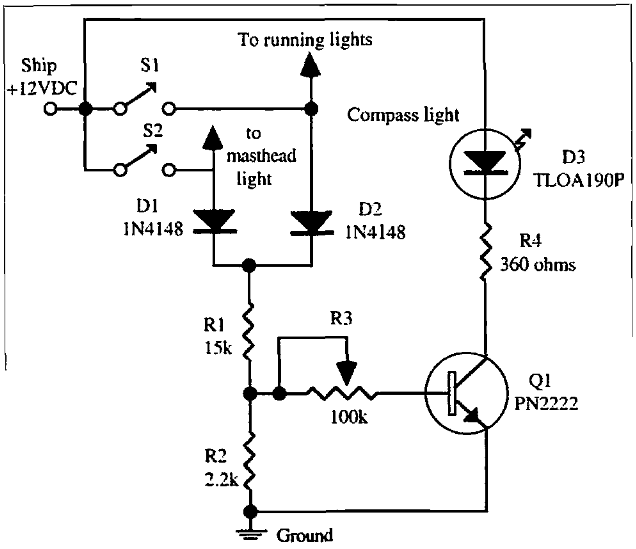


Fig. 1. N4UAU's solid-state compass "night light" idea. The compass light is illuminated when either the masthead light or the running lights are on. Potentiometer R3 controls the LED's brightness.

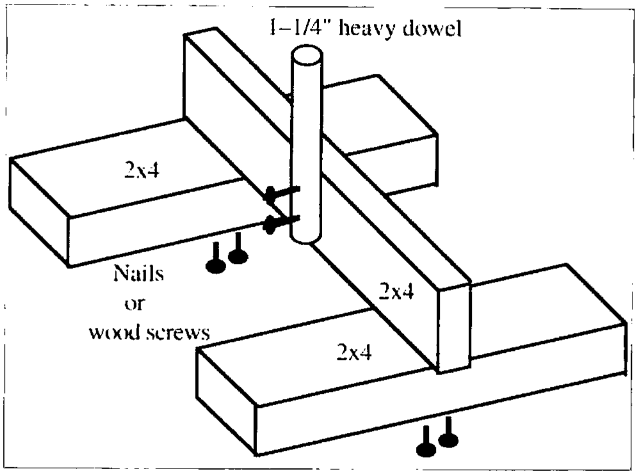


Fig. 3. AD1B's attic beam antenna suggestion.

and turn on the LED so that I can find quickly them. I used a 100Ω resistor in this application in order to keep the current draw low, so that the single lithium battery would last longer.

• I also use one of the TLOA 190P(WX) LEDs as my sailboat's compass light. The red light is more than sufficient and, again, doesn't affect my night-vision. Red is typically the color that all sailboats use for compass illumination, but the LED will last virtually forever. In this application, I'm also using a dimmer circuit (shown in **Fig. 1**) so that I can adjust the brightness according to my needs. The LED doesn't affect the compass's accuracy, since the low current drain results in a very small extraneous magnetic field.

• I tried using several TLOA 190P(WX) LEDs for the purpose of chart table illumination as Frank suggested. I tied several together in series, with a single current limiting resistor, and powered the series string from the ship's 12V battery, but these LEDs are so spot-focused that it didn't work well enough for me in this application. All I achieved were several bright red spots, fairly close together. Perhaps a less bright, less spot-focused LED would work better (as Frank recommended in his article), or perhaps a defocusing (diffusion) lens arrangement would help. I didn't feel that it was worth the effort in my own case to experiment any further at the time.

• I use the LED as a general night light on the boat... actually, I leave it on all the time. With a 2.2k resistor in series with the Toshiba TLOA190P(WX) and powered by the ship's 12V battery, current draw is a minuscule 5mA and it projects a nicely focused light on the companionway steps leading below decks.

• I've found that it's even useful for holiday decorations. As just one example, I put two of these Toshiba LEDs into a carved Halloween pumpkin, along with a little solid-state flasher circuit, to achieve a pair of 'winking goblin eyes,' much to the delight of the neighborhood kids! **Fig. 2** shows the basic LM555 flasher circuit that I used. There must be some application hidden in here for Christmas as well!

"No doubt there are many other uses for the Toshiba TLOA190P(WX) LED that I haven't touched on—let's see some more suggestions here in the 'Ham To Ham' column...we don't always have to talk radio! By the way, this LED is priced rather steeply at $3.50, but I feel that it has so many uses that it is worth every penny. LEDs have such long life expectancies, that prorated, over time, the cost is minimal. Like all solid-state lamps, however, be sure that you limit the current to a safe value with an appropriate series limiting resistor. This particular LED can handle 60mA, far more than most, but a 12V battery could destroy it instantly without the correct series limiting resistor. As mentioned before, this particular LED is bright enough, and focused enough, that you can actually see it on a wall 10 to 15 feet away... even during the daytime. It might even be used as an inexpensive 'laser pointer' for low-budget business presentations. And as with a laser, be very careful not to shine this LED into a person's (or pet's) eyes. It is quite intense and might very well result in damage. As with everything else, using common sense and obvious safety precautions, this LED has some interesting potential applications."

Moderator's note: Sam is a noted author of technical articles who enjoys sailing in his free time. Our thanks go to Sam for sharing these ideas with us and for a different look at the current possibilities with solid-state lighting. I've a feeling that it will be interesting to see what the future holds in this area of electronics.

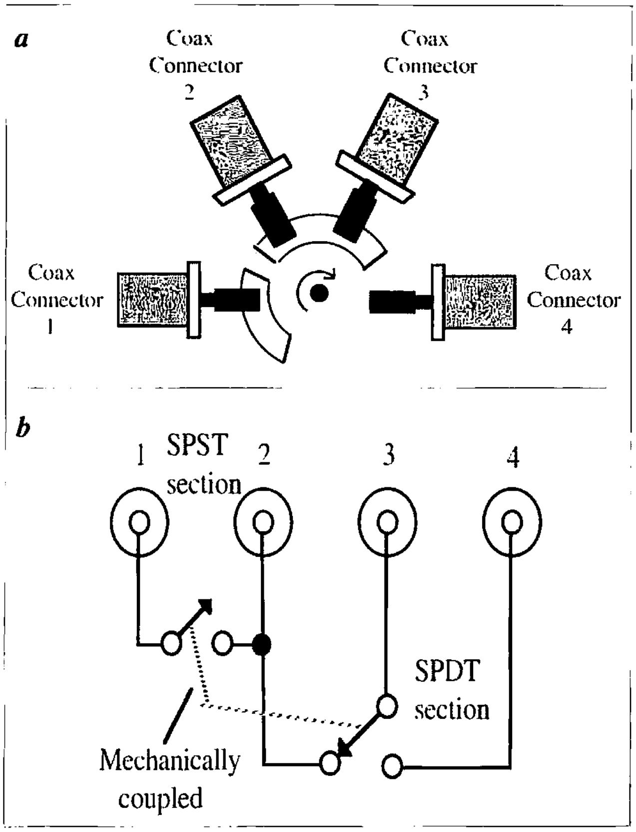


Fig. 4(a). Rear internal view of the B&W Model 551A coaxial bypass switch showing its inner construction. It's basically an SPDT switch (via connectors 2, 3, and 4) ganged with an SPST "secondary" switch (via connectors 1 and 2). The switch is shown in its normal (nonbypassed) position.
Fig. 4(b). Schematic of B&W Model 551A.

Beaming with pride

From Tom Hart AD1B: "A number of years ago, I bought a three-element Hilltopper™ beam for six meters. In fact, it was back in about 1968 and I suppose you could say I've been somewhat remiss in getting it up and on the air! But after all, this is 'just a hobby' and there's no big rush!

"At any rate, after purchasing the new MFJ 6-meter SSB rig, I decided it was now time to install my 3-element beam...still in its original box! A necessary adjunct to any antenna package includes a system for supporting it, as well as a rotation method and all the necessary cabling. Taking another look around at my yard and garage, I didn't see a good place to install everything in terms of 'quickly and easily,' two priorities in this project. My thoughts then turned toward the possibility of a third-floor attic installation. I considered the less-than-optimum height factor and the inside-the-roof losses.

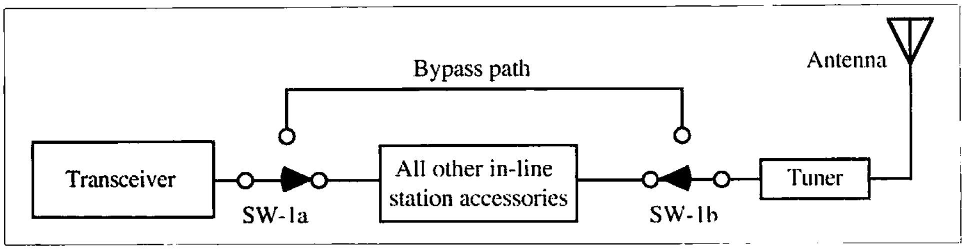


Fig. 5. Coaxial bypass switch being used to completely bypass all in-line accessories (with the exception of an antenna tuner) to eliminate potential sources of trouble quickly... without having to sign off the air.

but decided to give it try anyway. After all, it's just a hobby!

"Fortunately, my attic has ample room, so I set about designing the simple-to-build support structure (shown in **Fig. 3**). It had to be small enough to make it through the trapdoor access to the attic, yet large enough to support the beam and rotor as well as span the spacing between the attic rafters on which it sits. The bottom housing of the rotor, though not shown in the drawing, rests on the cross-2x4, maintaining the lowest possible profile and also adding to the stability of the installation. The beam, then, is mounted on another 1-1/4" dowel rod clamped to the top half of the rotor's housing, completing the mechanical installation. The two 2x4s that span the rafters can be glued, tied or perhaps screwed in place, to prevent any shifting of the mount during operation, if the sheer weight of the support system doesn't seem to be enough in terms of holding power in your particular case...it's an individual judgment call.

"I've been very happy with the results, it was easy to build and install, and it's served my purposes nicely. Wind and weather are obviously not considerations, and the beam should easily last another 30 years! Though not intended as a big DX grabber, my own primary interests on six meters are local contacts and checking into a few area nets. The indoor location has done that for me nobly. In fact, I'm now looking forward to building a two-meter quad to go above the six-meter beam!"

Moderator's note: Wow, Tom's attic must be a lot taller than mine, but his suggestions are well taken. Keep this easy support structure in mind if you think you can use an attic installation, perhaps to comply with no-outdoor-antenna covenants, or just to keep a lower profile in your overall antenna farm needs. Tom's support could even be taken up to the attic in pieces, and the final assembly quickly completed via pre-drilled holes for long wood screws, or it might simply be glued together in-place (using either hot-melt or quick-setting liquid adhesives). Before installing any antenna in your attic, however, make a quick RF check at or near the frequency that you're interested in using. Some asphalt shingles have aluminum strips on their underside... used to keep the 'seal-tab' from sealing to the next shingle before installation. These unseen metal strips can wreak havoc on the passage of RF energy through a roof covered with this type of shingle... I know first-hand—I've got them! After my new roof was installed a number of years ago, my off-the-air television reception was almost nonexistent from my attic-installed TV antenna. The next time my home needs reroofing, those shingles are going! A small battery-operated TV set or ham hand-held transceiver operated from up in the attic should tell you immediately if your shingles are the of the RF attenuating variety or not. A pocket TV tuned to Channel 2 to 6 will indicate how well six meters might work. Channels 7 to 13 give you a good idea about losses near our two-meter and 220 MHz bands. The UHF TV channels can be used to judge the results you might expect on 70 cm and above.

Don't bypass this!

From Ken Guge K9KPM: "You've probably seen them at hamfests, but perhaps you've simply walked by...I'm referring to those B&W bypass coax switches. Barker & Williamson makes a coax switch that can be used for bypassing a linear amplifier, receiver preamp or other coax-fed accessory... in case you might want to switch the device out of the circuit at times, with just a flick of the wrist. Sure, your linear amp already has a built-in bypass relay, and maybe your transceiver's RF preamp does too, but wait, that's not all that these handy bypass switches can do.

"If you'd like to be able to route your transceiver's signal around everything, all at once, the bypass switch can do it for you easily. Most of us have the output of our transceivers feeding into an SWR-metering circuit of some sort, maybe an external RF signal preamp, perhaps a linear amplifier, a monitor scope, an antenna tuner (variable antenna matching network), a low-pass filter, and often other necessary 'accessories,' all of which can cause problems of their own. Loose PL-259 coax fittings, bad cables, intermittent internal connections can all interrupt our QSOs even when the transceiver itself may be operating perfectly. A coaxial bypass switch in line is the answer and **Fig. 5** shows the idea in block diagram style. Just throw the switch into its bypass position and you can instantly work around any and all of these potential QSO spoilers! You can always troubleshoot the defective device later on—the main objective here is to keep you on the air now.

"A coaxial bypass switch can also be used to effectively ground your antenna's transmission line, and your transceiver's input, when the station is shut down for the night. **Fig. 6** shows one such arrangement. Of course you'll want to be sure to remember to place the switch in the ON-AIR position whenever you're going to operate, but its QRT position will help to protect your equipment from lighting or static-induced damage when it's not in use.

"On the test bench, a coaxial bypass switch can come in very handy for checking the results of a unit-under-test, by permitting you to quickly switch the unit in and out of the circuit (such as an RF preamp), in order to judge more accurately whether the unit is doing what it's supposed to do.

"I would guess that all the previously mentioned uses are more or less what the switch manufacturer had in mind when the decision was made to offer a product like this to the amateur radio market...but there's one more! I doubt that B&W

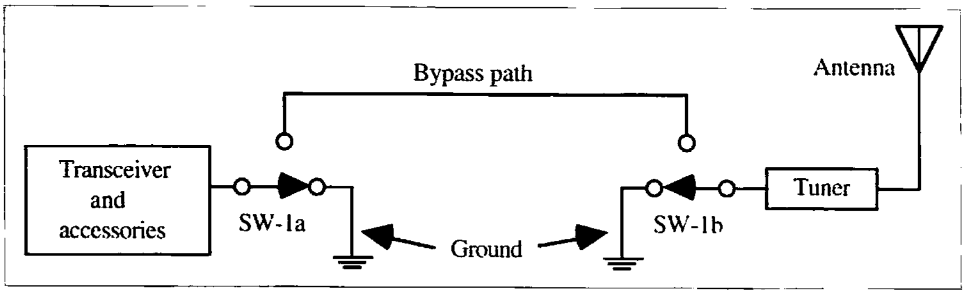


Fig. 6. Coaxial bypass switch grounds the station antenna and the transceiver's input during non-operating times to offer some protection against lightning and static-induced voltages.

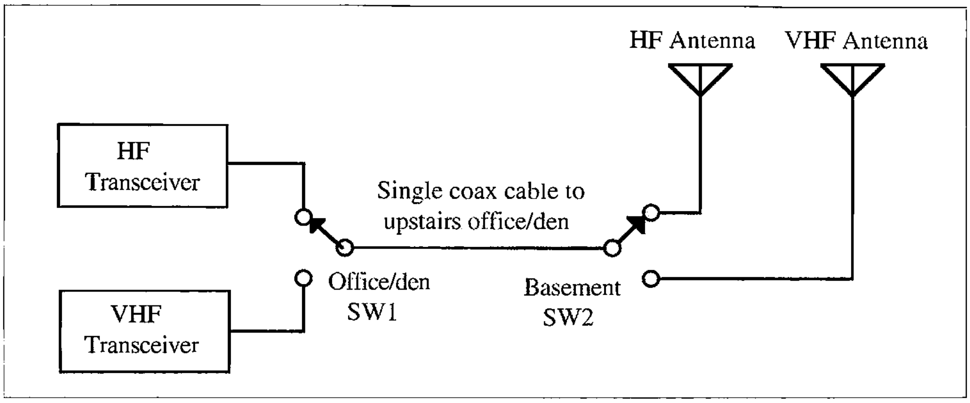


Fig. 7. Two coaxial bypasses being used as A-B transfer switches to permit one transmission line to serve for both HF and VHF operation at different locations within the same home station setup.

really intended their 551A coax bypass switch to perform as a two-position coaxial selector switch, but it can. If you look at how the switch is internally constructed in **Figs. 4(a)** and **4(b)**, you can see that it's basically an SPDT switch ganged with an SPST 'secondary' switch. Ignoring the SPST 'secondary' section and connector #1, you can utilize the SPDT section as a standard two-position coax switch (an A-B switch). For instance, connecting a coax cable between connector #3 and your transceiver's output, you can switch between two separate antennas connected to connectors #2 and #4. You can also use the same idea in reverse to select between two transceivers and one antenna by connecting the antenna to #3 and the transceivers to connectors #2 and #4 respectively.

"I'm using a variation on that idea in my own station as shown in **Fig. 7**. In the cold weather, I prefer to do my HF and VHF operating from my upstairs office/den, rather than from the chillier basement ham shack. With an SPDT coax switch on each end of the line, I can use a single coax cable running up to the den by using the **Fig. 7** hookup. There are many other uses, limited only by your imagination and your own particular switching needs. I hope these suggestions have provided some food for thought for fellow 'Ham To Ham' readers...and remember: Don't pass up this little gem at your next hamfest, it's not just for bypassing any more!"

Moderator's note: Ken always seems to bring out innovative and surprising uses for devices that many of us would never have thought of on our own... thanks for another, Ken. By the way, the manually activated bypass switches that Ken referred to come in voltage-actuated coax relay form as well. I've been using a 120V AC actuated coax bypass relay in my own station to switch my conglomeration of in-line accessories out of the circuit between my transceiver and my antenna in an emergency...and it works nicely (I've had to use it a few times, too!). Again, you can often find these bypass relays at hamfests with 6V, 12V, 24V and 120V coils (both in AC & DC varieties). Just be careful that you know what voltage you're buying and that the coil reads continuity with an ohmmeter (you do carry a pocket-sized VOM with you to the hamfests, don't you?).

Murphy's Corollary: Any electronic component, selected at random, from a group of components having 99% reliability, will fall into that 1% remaining category!

Remember to keep your ideas coming this way; I'm always looking for worthwhile tips, ideas, suggestions, shortcuts and innovative ways of doing things in and around the ham shack... like those in this month's offerings. So again, as always, many thanks to the contributors to this month's column, including:

Sam Ulbing N4UAU
5200 NW 43rd Street
Suite 102-177
Gainesville FL 32606

Tom Hart ADIB
54 Hermaine Avenue
Dedham MA 02026

Ken Guge K9KPM
1107 E. Woodrow Avenue
Lombard IL 60148

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73 Magazine, *and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or* 73 Magazine *for any equipment damage or malfunction resulting from information supplied in this column.*

Please send all correspondence relating to this column to *73 Magazine's* "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

NEVER SAY DIE

Continued from page 83

the speed of light you have a huge amount of energy released. This is how Dr. Patterson's CETI group has been able to demonstrate efficiencies of up to 2,000 times more energy being produced than is going into their test cells.

No, they didn't teach the transmutation of elements when I went to college. They're *still* not teaching it, but they will be in a few years. Heck, when I went to college the very idea of solid state electronic devices was ridiculous. If anyone had been able to teleport a Power PC chip back through time the entire resources of the world could not have duplicated it, much less today's LCD color laptop screens.

My predictions of four years ago, when I started writing about cold fusion, haven't changed—they've only been substantiated by researchers in Japan, Russia, Italy, India, France, and the US. I'm more convinced than ever that this is going to be one of the largest industries in the world in another 20 years.

Hey, you snickered and ridiculed me 20 years ago for writing in my editorials that the personal computer would one day rival the automotive industry in size, with computers in every home. Now I chuckle every time I hear a radio ad for software, or see TV ads for personal computers.

And just as the opportunities for getting in on the ground floor were there for the enterprising 20 years ago in the computer field, today they're wide open in the soon-to-be new energy field. Will Dennis Cravens, who started out building cold fusion reactors in his basement a few years ago, be one of tomorrow's zillionaires? The chances are very good. Despite the enormous resistance of our scientific elite and the power companies, Dennis and Doc Patterson are laying th e groundwork for a world ß"of almost unlimited low-cost non-polluting energy. And Dr. Kozima is busy explaining to any of the scientific community not totally blindered the hows and whys of what's happening.

Including Ham Radio Fun!

JULY 1997
ISSUE #442
USA $3.95
CANADA $4.95

International Edition

73® Amateur Radio Today

ATV Special Issue

Rockets & Balloons
Power Supplies
Preamplifiers
Antennas

Reviews:

LDG 'Tenna Tuner
Ramsey's Dr. NiCad

0 74851 08275 1 07

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article [IBM (ok) or Mac (preferred) formats], carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

73 Amateur Radio Today

Including Ham Radio Fun!

JULY 1997
ISSUE #442

TABLE OF CONTENTS

FEATURES

REVIEWS

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: Al Wright of Huntsville, Alabama, prepares HALO ATV rocket for maiden voyage to 30,000 feet. Photo by Bill Brown WB8ELK. See "Rocket Video" (page 35) and "ATV" (page 50) for high altitude adventure. Need some cash for that new rig? Send us your possible cover shot photos, gladly returned if not purchased.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107.

The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

What More Can I Say About Hamfests?

A note from Walt Bastow N4KVF suggested I comment on the disintegration of our major hamfests. Okay.

When around 90% of the local hams don't bother to go to a hamfest or convention it should be taken as a sign by the organizing committee that maybe the event isn't perceived as worth the time and price. Not enough fun. Bo-o-oring.

As I've pointed out before, I went to my first hamfest in 1938 and though the world has changed beyond belief, hamfests haven't. As with the code, amateur radio seems firmly mired in its past—anchored there by the ARRL and its CW-fixated board. Take a look at a 1937 issue of *QST* and tell me what differences you find in 1997, sixty years later. Small cosmetic changes have been made, and that's about it. About 70% of the magazine is still advertising and club news.

If hamfests are going to survive they need to be re-invented. With attendance dropping fast, it's getting harder to attract exhibitors. The main things a hamfest has to offer are the commercial ham exhibits, the flea market, and speakers. How many hamfests have you bothered to attend in the last couple of years? If any one of them had an exciting speaker, please drop me a QSL card with his name. In my experience there's a good reason why the talks at hamfests draw so few listeners—they're dull. I've sampled many of them, just to see for myself.

I've already written about my ideas for making hamfests into 1990s entertainment, but I've seen no sign that anything has changed.

With around 60% of today's hams feeling disenfranchised by the League because they are Novices or Techs, they're not big on joining ham caravans driving to the big hamfests. Their ham friends are all in their local repeater area, not spread around the country. And they are not enough into ham satellites and other ham special interests to want to spend the time and money to get together with similarly-interested hams from outside their area.

I've never seen any hint in the many club newsletters I get, nor any word from a reader, suggesting that any hamfest committees have done any opinion surveys to find out what hams like and don't like about hamfests. So I'll do one right now.

If you've been to a hamfest in the last couple of years, what part of it was the most fun for you? What might the hamfest committee do that would make it more fun? Have you passed up going to any hamfests, and if so why? Can hamfests be salvaged or has their day passed?

A few years ago *CQ* Magazine announced they were launching a series of commercially run hamfests. Far's I know the series ended with the first gigantic flop.

One of the problems, I suspect, has to do with money. Hamfests can be very profitable for the organizers, with one group reputedly skimming hundreds of thousands of tax-free dollars. This has tended to continually increase both the attendance price and the cost of booths for exhibitors, while keeping promotional and other expenses to a minimum. With so much money floating around and so little accountability, there's bound to be mischief. And since most hamfests are chaired by a ham with little experience in running big events or in dealing with large amounts of cash, it's no wonder we hams have, in the long run, been shortchanged.

I'd like to see hamfests used more as promotional events to get kids interested in the hobby, with major promotions to bring the kids in and entertain/educate them. How about a ham in a balloon with an HT talking with kids on the ground, complete with a ham video camera showing the guy in the balloon talking?

How about a slow-scan TV demo with someone in Africa or Europe on schedule, letting the kids talk to the chap they're looking at? Now you think up some stunts which will get the kids excited.

Folks, it's grow or go. Your choice, but please don't look around for any leaders to follow. We haven't any.

NASA Confirms Cold Fusion Excess Heat!

Using a nickel-potassium carbonate (light water!) cell NASA scientists confirmed and reconfirmed the cold fusion excess heat phenomenon. Using different current levels and one pulsed current test their power gains ranged from 1.06 to 1.68. The tests were run by the NASA Lewis Research Center Group in Cleveland, Ohio using a cell borrowed from Hydrocatalysis Power Corporation.

The cell had previously been producing "Fifty watts of steady excess heat for a continuous period exceeding hundreds of days."

The report concludes, "Considering the large magnitude of benefit if this effect is found to be a genuine new energy source, a more thorough investigation of evolved heat in the nickel-hydrogen system in both electrolytic and gaseous loading cells remains warranted."

The report covers the history of the Pons-Fleischmann announcement and the quickly-following negative reports from Harwell, CalTech and MIT—which, interestingly enough, easily found publication in scientific journals, while positive reports were denied publication.

The report points out that modern cells of various types "have power multiplication factors over 10, and have achieved powers as high as ~4kW/cm^3. If true, such data clearly exclude by orders of magnitude an ordinary chemistry explanation and force one to consider various lattice-assisted nuclear channels."

NASA's obvious interest is as a "power source to replace radio isotope thermal generators for planetary spacecraft."

Considering, from what we know now, that the cell used 0.5 mm nickel wire for the cathode, we can understand the delays in loading hydrogen into the nickel lattice, and the relatively low power gains achieved. Patterson and his CETI group have been reporting gains in the 1,000 and up range using powdered and thin-films of nickel.

You can get your very own copy of this NASA report by asking for N96-22559. My Congressman, Charlie Bass, got one for me.

Will word of this NASA report ever reach the Department of Energy?

Nut Nut Nut Nut Case

I plead guilty to being a nut. I'm a radio nut, a car nut, a camera nut, a health nut, a UFO nut, a ski nut, a scuba nut, a gourmet nut, and so on. Oh yes, a computer nut too. And a classical music nut and cold fusion nut. I'm so nutty I practically rattle when I jog.

Now, with my health nut beanie in place, propeller spinning, driven almost to levitation speed by the force of my emanating brain waves, let's talk about the bioelectrifier. Yes, it's a great little gadget, and ridiculously simple to build and use. But it does tend to cater to the need for people's immediate gratification.

The more I read about health, the more the pieces all fit together—and the picture is a mess. Let me explain.

If you want to have a healthy body you need to provide it with the raw materials your body used as it developed over the course of a million years or so. The main reason we're sick and dying 20-30 years before we need to is our not providing our bodies with the building materials they were developed to use.

Like what? Heck, we've got one of the best food supplies in the world, right?

Umm, not quite. Yes, I've written about some of this before, but you need a refresher.

Your body needs air, water, sunlight, the foods it was designed to use, exercise, and a relative freedom from stress. It also needs a freedom from poisons.

Take water, for instance. Just look at the stuff you've been drinking! It's got added fluorides, chlorine, dioxin, lead, copper, and stuff like that. Are you drinking distilled water yet? Are you drinking at least eight glasses of distilled water every day? That's what the body uses to help flush out the poisons which would otherwise accumulate. There are four excellent books on water in my guide to books you're crazy if you don't read.

Sunlight. Sure, too much can be damaging, but for 99% of us (or more) it's too little. We keep those "harmful" UV rays out of our eyes with glasses, windows, and so on. If you'll read a couple of books on light by Ott and Lieberman you'll be out there with your glasses off getting UVs into your eyeballs on your morning walks. Our eyes and skin need sunlight. In moderation.

The worst is our food supply. Hey, don't believe me about this, put me down as a nut. But at least do me the courtesy of doing your homework. Dr. Joel Wallach and his "Dead Doctors Don't Lie" tape may have some exaggerations, but he's right about the vitamins and minerals being long gone from our supermarket foods. You either take supplements or you get sick and die. Usually painfully. Read his *Let's Play Doctor* book—also his *Rare Earths*, which I'll have to add to my reading guide. Do your homework and then tell me I'm a nut.

You must have read about all the crud they're putting in our meat supply. Antibiotics, hormones, and so on. That just makes those Whoppers and Big Macs all the more deadly. And the movie theater popcorn popped in artery-clogging goo.

Poisons? Like alcohol, nicotine, aspartame, mercury, fluorides, caffeine, immunization shots.

Two of my favorite TV programs are "The Simpsons" and "Roseanne." Both feature big fat constipated-gut beer-drinking fathers. I enjoy the programs for the writing, though Roseanne's show has gone downhill substantially since losing Dave Raether as an associate producer. Both fathers spend most of their time drinking beer and watching ball games on TV. What a terrible way to waste one's life. Instead of learning and contributing to the world, they sit staring dumbly and poisoning their bodies. Great role models.

Our ancestors spent a lot of time out in the sun, got lots of exercise, and ate mostly raw fruits and vegetables grown in mineral-rich soil. No poison sprays.

By the way, if you'll read *Secrets of the Soil*, you learn that insects only attack sick crops. If you give the crops the minerals they need instead of chemical fertilizers the bugs won't bother them.

Far's I know they don't teach any of this stuff in school. Not even college. So how can a person find out about how bad our water and food supplies are and what to do to live a healthy life?

How many really healthy people do you know? My mother fed me pretty well when I was a kid, so I had such outstanding teeth that dentists would call in their assistants to look at them when I had my checkups. It wasn't until after I went away to college and then joined the Navy that I had to have my first filling. It wasn't until my sophomore year in high school that I even tasted soda pop or a Coke. White bread and sugar? Cold cereals? No way! I still love all hot cereals, and without any sweetening.

Once you start doing your homework I'll bet you'll get excited over thinking and start making a similar nuisance out of yourself trying to get others to turn off the TV and start reading. The mind is like a muscle; the more you use it the stronger it gets.

So let's start with stuff that has an immediate application in making you healthier. If you give your body a break you're not going to need a bioelectrifier to get rid of viruses, microbes, parasites, yeasts, and fungi in your blood because your immune system won't permit them to set up shop in the first place. Our bodies come with a fantastic error detection and repair system. Given an even break your maintenance system will keep you stroke, cancer, and Alzheimer's free for life. You can go visit your old friends in their nursing homes, and then visit their children in the same homes a generation later.

Now, isn't it about time to start repairing the damage you've done to your body? You've got a truly amazing repair system built in—one that can keep you alive despite all the poisons and poor nutrition you've insulted it with. Just give it a real chance to do its work.

If my lecturing is annoying, shrug it off. But what I wish you'd do is make a list of your chronic illnesses and then seriously change your pattern of living and keep track of the gradual elimination of fat, arthritis, and so on. And let me know that I've helped. I can live with the cat calls and ridicule from the nonthinkers if I'm able to reach a few readers and help them have happier lives.

Stress? Yep, that's a big factor too. Indeed, every illness has a psychological component, so maybe it's time to start solving your stress problems.

End of lecture. For now.

Quid Pro Quo

That's Latin for getting something for something. Like what does the public get from us in return for our allocation of billions of dollars in frequencies?

A 13-page special invitation to join the AARA as an alternative to the ARRL almost got me to thinking. Now, if the American Amateur Radio Association were a legitimate (in my eyes) group, at this critical time in our history I'd say that it would be folly to get involved in a civil war.

So, am I saying, "In union there is strength," join the ARRL? The strength of a union is only there when the union members have some say in the running of their union, and from everything I've seen, the average ARRL member hasn't even a nano-voice in the ARRL. The ARRL Board will listen to you up until they get your membership check. When you send in your membership you are paying for some hoped-for future service (like the survival of the hobby). When you refuse to pay up until you see some significant signs that you are going to get the service you want, that puts pressure on the tight-knit old-boy group running the League to actually do something. They'll do a lot to get your money, but little once they have it. That's just plain old human nature at work.

The AARA, a.k.a. Glen Baxter K1MAN, looks to me like a new pyramid scheme with Section Managers getting a 10% piece of the action for every new recruit and State Directors getting 5%. Membership seems to be $35 a year. Then there's the American Amateur Radio Council (AARC), where membership costs $250 a year. That's a division of the AARA. Then there's the Amateur Radio Management Consultants (ARMC), the Foundation for the Advancement of Amateur Radio (FAAR), the Domestic Amateur Radio Emergency organization (DARE), the *American Amateur Radio Digest* (*AARD*), a monthly newsletter, the International Amateur Radio Network (IARN), the Amateur Radio Peace Corps Foundation (ARPCF), the American Amateur Radio School (AARS). And so it goes. It looks to me as if Glen has built a "Potemkin Village" one-man organization in order to take advantage of the present weakness of the ARRL.

The League's stand on the code has made it seem irrelevant to about 60% of the licensed hams. Talk about a death-wish!

Worse, from what Glen Baxter is saying, he's blaming the ARRL for the influx of no-code hams and promises his AARA will push for "higher quality hams." He calls the ARRL "corrupt, petty, irrelevant, and overly commercial," with a "Neanderthal Mental Midget Mentality." He seems to be concentrating entirely on his pyramid of Section Managers to solicit membership from already licensed hams rather than pushing them to get kids involved to build up our numbers. No mention of that.

I've found Glen to be a dedicated man—overwhelmingly dedicated to promoting Glen.

We don't need a civil war in hamdom right now—what we

Continued on page 26

LETTERS

Number 6 on your Feedback card

From the Ham Shack

Bill Mayers, Canastota NY. In the May issue of *73*, you said you had never received a negative report on the "Bioenergizer." I sent you such a report, and you ignored it. Shortly after it was first described in your magazine, I built one and began using it. I told you that within six months, I developed irritable bowel syndrome and diabetes, and began experiencing migraines. You did not respond. You have a habit of taking the "medical establishment" to task for failing to own up to the fact that some of their products can be hazardous. Wayne, to fail to tell your readers that I have found this device to be dangerous (diabetes is a deadly disease), you are being even more dishonest, by pretending to be a guardian of your readers' well-being, yet pushing a useless and dangerous product. Show us there is a difference between Wayne Green and the crack-dealing creeps who lurk around our children's schoolyards. Print a retraction.

By golly, you are right and I was wrong. I should have said that I hadn't received any credible negative reports. Diabetes, eh? Normally that takes several years of misuse of one's body to develop. And migraines normally stem from the same cause as irritable bowel syndrome. You have not been doing your homework and I have. Both the Coca and Wallach books, which are recommended in my guide to books you're crazy if you don't read, cover these two allergy problems. These symptoms have nothing to do with any virus, microbe, parasite, fungus or yeast in the blood. By the way, Wallach covers the cause and a simple cure for diabetes in his book. I've already written about why crack dealers are making so much money. We can thank the government for that beaut. Based on the Albert Einstein College of Medicine discovery and patent, plus the reports from Bob Beck and quite a few readers, the bioelectrifier makes good scientific sense to me. I can see where, after extended use, one would want to replace any lost beneficial microbes via acidophilus milk. I am anxious to hear about any positive or negative effects. Is this going to turn out to be the medical industry's worst nightmare, or just another placebo exciter?... Wayne.

Michael Borer WL7CKB, Anchorage AK. Re the AC5HU comments on the ARRL "code survey," I am sure glad to find someone else that was not taken in by the "Anti-Revisionism Radio Louts" either. The ARRL sends out an opinion poll on whether or not to keep the ANTIQUATED CW requirement for HF licensing and what do they do? They "Sing to the Choir" of the already converted. Now I, for one, am definitely not in favor of the elimination of CW from our bands, but since all the ITU requires is a "knowledge of code" to qualify for the HF bands, and since even the FCC, in their "Notice to Physician," on the back of the Form 610, states that a 5 wpm proficiency is all that is required for our physically challenged hams, why should the rest of us be forced to meet the overinflated, arbitrary and capricious code speeds?

While the ARRL continues to discriminate against the vast majority of licensed amateurs, there is one group, the "Code 5" group, headed by Guy Matzinger KB7PNQ, 503 Dubois St., Cheney WA 99004-1325, fighting to have the code requirement reduced to a sane 5wpm speed. All interested, licensed hams should contact Mr. Matzinger and sign the petition that he is circulating and even help financially, if at all possible, so that he can go before the FCC with a big stack of ham signatures in favor of a change in licensing policy.

Now, I know that there are those out there that will scream that we are trying to lower the standards for receiving a ham license, but nothing could be farther from the truth. Since this is a technical hobby, not a physical training hobby, I would propose a toughening of the technical aspects of the exam, not perhaps to the point of having to draw and build a circuit, but definitely having to learn about antennas, packet and all the various modes of communication. If we want to push the technological envelope again, as we once did, it is definitely time to quit wasting our precious time with a physical training exercise, and learning a mode of communication that virtually all other entities, both private and government, have discontinued using.

Good grief, another troublemaker! ...Wayne.

Lionel C. Allen VK6LA, South Como WA. Here's a bit of midnight reading for you. Your April *73* mentioned dowsing. Here's an experience I had years ago. Dowsing with an odd twist. I was on Air Force leave and visited a very respected and quite elderly neighbor right across the road from where my family lived. He had taught my brother, some 12 years older than myself, a lot about black and white photography, as he did with me years later. On this visit the general talk turned to dowsing. Not just the simple finding-water stories, but also health diagnosis by utilising various minerals held in his hand and short-length pendulums. I seem to remember being diagnosed as having a shortage of some mineral or other. Quite frankly, I didn't believe the stories he told, but on the other hand, this gent just did not tell lies. Additionally, he had all his experiments carefully written in a small notebook.

Then we went outside to carry on some traditional water dowsing. My elderly neighbor was absolutely certain he could teach me the basic art of finding not only fresh water, but trails of impure water created by sewerage contained in underground plumbing. If the neighbors thought it a bit weird as a 19-year-old and an 80-year-old wandered up and down the yard hand in hand, they didn't comment. For my part, though, not a single twitch was generated from pieces of wire, various twigs, and so on.

Some time later I was posted to a fairly remote location at an Air Force transmitter station in Northern Australia. With only six staff in all, and as it was an easy-going job, I took to walking some of the trails well marked by, and used by, Australian aboriginals. Purely by chance, I one day broke off a small branch of a tree and soon had a traditional dowser's forked branch held out in front of me. To my astonishment, the dowsing fork gave a very strong reaction in two separate locations not far from where the camp was set up. I traversed the area for a good hour, but only those two exact locations gave any response over a good half mile or so. I went back to our small mess and spread the word!

Naturally, there were the usual nudge-nudge, wink-wink remarks, but enough enthusiasm was aroused for others to try their skill. I explained the general idea and got four of the other fellers lined up at a good distance apart and headed them off down the track I had just walked. I declined to tell them where the actual dowsing reaction had occurred. Also, I asked them not to indicate to each other if and where they might receive any dowsing response. Again, and you've guessed correctly, in the exact same locations four out of the five of us got reactions. The general dowsing enthusiasm lasted long enough to convince several of us there really was something in this business after all.

However, the story isn't quite complete. As enthusiast number one I dowsed the whole damned area without any other really good responses! That is, until one day I began to realize that every time I headed out around the camp and under every overhead feeder line from the transmitter station, I got a strong response. Obviously, from the overhead lines. For some reason, I was the only one of the six to get these reactions. Now, the feeders from the reasonably large number of antenna systems covered a lot of territory. As others didn't get the same reaction, it was either provide further proof or call the men with the little white coat.

So, well and truly blindfolded, I was guided around the general area and periodically under the

open wire overhead feeders. Well, blindfolded or not, I was infallible! So how about that for a twist, Wayne? I hope one of your books doesn't have a method of making a million out of overhead feeder line dowsing because I never ever found any use for it. At least I was converted from a nonbeliever to a firm believer and had a fair bit of fun in the process.

Hey, I wonder if it stemmed from the group I played with as a youngster—we were the greatest kite flying enthusiasts for miles around. With plenty of open space around in those days, a dozen or so of us would take off with kites up high and well out in front of us in the afternoon sea breeze. All power reticulation was overhead, but we would take off in line and walk slowly for I'd say about a mile. At each block the older kids would run out some extra string and then hurl the ball over the top of the power lines! I never once recall seeing a ball caught up in the power lines but I guess it happened. At the end of the walk we'd reel in the kites and walk back home.

I've never ever since seen kids repeat that sort of kite flying. Maybe I was lucky. Perhaps I was lucky to spend a lot of time living with my aunt and uncle on a wheat and sheep farm. Many times we would harness two or more large kites together and launch one of the farm dogs up for a ride up in a bag harness. We never ever had a complaint from the dogs and they apparently didn't mind too much either, as they would always join us from day to day. Not that I recall ever getting one up much higher than twenty feet or so. I'd reckon not too many kids did that either!

Gosh, and I was going to tell you how I've been trying to whip up a bit of enthusiasm in amateur radio. Never mind, I'll write again. Now you can go back to sleep!

Zzzzzzz. Lionel, this is a ham magazine and you're supposed to write about ham radio, not dowsing and kites. Got that? On dowsing, any nudge-nudgers should not read the Owen Lehto book, Vibrations, *which is ... of course ... in my reading guide ... Wayne.*

Jan Medley KBØWQT. *73* has a well deserved reputation for "pot stirring" and I usually regard that as a big plus. But sometimes a columnist goes right off the rails and needs a reality check. Such was the case with Joseph Carr's column in your May issue. "There is no excuse for offering MS-DOS software any longer," says Mr. Carr. He's entitled to his opinion, but he should know better than to make such categorical, unsupported statements with complete disregard for the facts. As a long-time personal computer user of both Windows and DOS software, I found the column insulting, misleading, and generally worthless—even if one ignores the question of what a column on software design might be doing in a ham radio magazine. Here are some facts:

1. First and foremost, Windows 95 (and its predecessors) is ... wait for it ... a DOS program. It is a GUI and a number of utilities for memory management and hardware management including multi-tasking, but if you look under the hood you will find that DOS is still there as the Disk Operating System. For whatever reasons, Microsoft may have fooled a lot of people by changing file names and "kernelizing" DOS, but you have to look to NT in order to find a version of Windows that is actually an operating system in its own right. This is a lost battle, I know, and the end result is that most users will think Windows is an OS, but the point is that anything that can be written for DOS can run "under" Windows, and any Windows program is ipso facto a DOS program as well.

2. Not everyone can afford the hardware necessary to support a Windows 95 installation. Starting price is close to $2,000, while DOS machines are commonly

Continued on page 55

QRX . . .

New "Ark" for WB6NOA

After 20 years of faithful emergency communications service, the Gordon West WB6NOA black station wagon will retire and "NOA's ARC," a new Amateur Radio Communications vehicle, will take over. Gordo indicates the new ARC unit will be used for classroom demonstrations as well as VHF/UHF/microwave DXpeditions.

"This new unit will be added to our water-grid arsenal, now allowing us the capabilities of attending regional ham shows, and having all of our microwave equipment onboard," he said. "It will also serve as an emergency communications vehicle for our local American Red Cross chapter, plus emergency communications for the city of Costa Mesa."

West's new communications vehicle is built around a Chevrolet 22-foot G30, a 1-ton extended van chassis with a 7.4 liter 454 CID EFI V8 gas engine. There will be a 4.5kW generator installed beneath the rear radio operating area to provide plenty of power for all the amateur radio equipment onboard.

The upper portion of the vehicle, built by Home & Park Motorhomes in Ontario, Canada, is called "Roadtrek." The roof is Fiberglas™, but contains built-in copper screening for good RF shielding between the antennas and the passenger compartment.

"All of the antennas will feature lip-mount and gutter-mount technology from the leading antenna manufacturers like Diamond and Comet. We will also have a motorized antenna lay-down mount from Maldol," West continued.

His idea of "no holes" was to specifically test the new generation of antenna mounts that secure firmly to almost any ridge, lip, or metal edge. "We will even run a full-length, high-frequency whip off of the rear door tire mount, and again, we will go only with off-the-shelf antenna mounts available at all ham radio stores," he added.

Built into the screen area separating the metal sides of the vehicle and the Fiberglas roof will be an automatic high-frequency antenna coupler with a long-wire attachment. "This could allow us to string up a long wire, using the screen as well as the chassis sides of the vehicle for a great ground plane system," he said. "We will also be able to put a strong signal on 75m, the coordination band for weak-signal tropo and meteor scatter work."

Long-boom yagi antennas will be carried on the inside of the vehicle. The booms would be separated so as not to exceed the length of the vehicle. The yagis would operate either fixed-direction or, for now, via the "Armstrong" rotor system.

When it comes to the ham radio equipment on the inside, West claims that each and every manufacturer of amateur radio equipment will be represented.

"We will have 160m through 10,000MHz ... and this will allow students to enjoy hands-on exposure to every brand sold through dealers or direct, and this way our mobile classroom will support everyone in the industry equally," adds West.

Plans also call for large magnetic signs, indicating AMATEUR RADIO ON THE AIR, so that the vehicle may also travel as an amateur radio information center. "We plan to make this unit very visible during amateur radio operating events like Field Day and Simulated Emergency Tests. We will also carry amateur radio information packages, including amateur radio magazines, ARRL information sheets, and ham publications, along with manufacturer frequency charts and *Welcome to Ham Radio* guides," West sums up.

There will be three operating positions inside the vehicle: the front for high-frequency; midsection for VHF and UHF; and the rear area that will carry satellite and data equipment.

"I look forward to working many stations on the air from NOA's ARC," smiles West. Plans call for a West Coast "shakedown," and then looking into other engagements throughout the rest of the country. Gordon West's wife, Suzy West N6GLF, looks forward to driving while "Gordo" scurries around inside, keeping everything on the air "ARC Mobile."

ARRL Calls on FCC to Privatize Handling of Malicious Interference Complaints

Citing "a substantial need to improve and increase the quantity and quality" and timeliness of enforcement in malicious interference complaints, the ARRL has called on the FCC to "create a streamlined, privatized enforcement process" to handle and adjudicate the most serious Amateur Service rules violations. In a petition for rulemaking filed March 28, the League asked that the FCC change its rules to permit members of the volunteer Amateur Auxiliary to bring evidence of malicious interference violations directly before the Chief Administrative Law Judge. The chief ALJ would be authorized to determine if the complainants have a valid case, to issue show-cause orders, and to designate complaints for hearing.

The League recommended that the FCC capitalize on the volunteer resources available through the Amateur Auxiliary to relieve the evidence-gathering burden in such cases. If the rules' changes are approved, the League said it would likely assist members of the Amateur Auxiliary in preparing and submitting complaints and in presenting cases at administrative hearings. "The increased use of volunteer resources would seem to be entirely appropriate in the Amateur Service, which involves avocational use of radio only," the ARRL concluded.

While noting that most hams obey the rules, the League said Amateur Radio needs the commission's help "in a very few, persistent, serious enforcement cases" but has not been getting it in recent years because of the FCC's staff and budgetary limitations.

"Indeed, notwithstanding the best efforts of the Commission over the past several years, there has been no resolution of the four or five most serious cases brought to the Commission's attention," the League said in its petition. Even in some of the cases the FCC did act upon, the League said the Commission did not go far enough to make the problems go away permanently. The League cited a case in New Orleans where fines against several amateurs were reduced but remain unpaid and uncollected. "There is a widespread, and growing, perception that administrative forfeitures are not collectable," the ARRL said, pointing to the complex, time-consuming method of collecting fines that is required by federal law. The ARRL noted that while the FCC suspended one ham's license in that city in 1996, it failed to look into malicious interference charges against at least two other hams in that area. The League said examples like these send a message that the FCC won't enforce Amateur Service rules in malicious interference cases. Informal mediation attempts also have failed. "Malicious interference problems, if left unchecked, tend to spread and increase in intensity," the League said. The ARRL suggested that a series of "visible, successful enforcement actions" would deter rules violations and promote self-regulation.

The ARRL also suggested that some FCC policies get in the way of timely, effective enforcement. Current Wireless Telecommunications Bureau policy requires the Commission to independently

corroborate evidence gathered by Amateur Radio volunteers. "The policy often acts as an absolute obstacle to any enforcement activity whatsoever" and it demoralizes volunteers, who view their efforts as wasted.

While noting that malicious interference cases often attract a lot of attention within the amateur community, the League said ham radio can be "justifiably proud" of its history of voluntary rule compliance. "The overall level of compliant behavior among amateurs has not deteriorated over the years," the League emphasized, citing fewer than 10 active malicious interference cases in the US at present.

TNX *Tuned Circuit,* monthly bulletin of the L'Anse Creuse (MI) ARC, May 1997, from the ARRL letter.

Lights! Camera! Action!

Some ham radio paraphernalia supplied by the ARRL will appear in the upcoming Warner Brothers™ film, *Contact.* The League loaned the movie makers vintage *QST*s and other publications and maps for use in the production. Mike Gastaldo of WB's props department said the radio shack scenes "happen in the first 15 minutes of the film. You can tell people to go for the ham radio scenes and stay for the astrophysics."

Gastaldo expressed thanks to the League for "helping us to portray Amateur Radio in as realistic and positive a way as possible." The movie is scheduled to open July 11.—ARRL.

From the *Tuned Circuit*, monthly bulletin of the L'Anse Creuse ARC (MI), April 1997.

Phase 3-D Launch Delayed Until September, 1997

Paris, France (AMSAT News Service)—In a formal announcement from Paris on March 24th, the European Space Agency (ESA) said that the second test flight of their new Ariane 5 booster has now been rescheduled from July to mid-September, 1997. It is this flight, Ariane 502, on which Phase 3-D is currently manifested.

According to their latest announcement, this action was being taken by ESA and CNES (the French Space Agency which manages the Ariane 5 program for ESA) in order to "improve (the booster's) robustness, increase the operational margins and allow for degraded operating modes."

In a joint statement a day after the ESA announcement, Phase 3-D Project Leader and AMSAT-DL President, Dr. Karl Meinzer DJ4ZC, along with AMSAT-NA president Bill Tynan W3XO, expressed continuing confidence that ESA and CNES will succeed in completing all the tasks necessary for a successful flight test of Ariane 502.

"Naturally, we were disappointed that our launch will not be as soon as we had hoped," said Meinzer. "However, I am pleased that ESA and CNES are taking care to improve the operational margins for the Ariane 5 booster. This action helps give us renewed confidence in the overall probability for a successful launch of our satellite."

Both Meinzer and Tynan emphasized, however, that this launch delay, like the earlier ones, means that the total cost of the Phase 3-D Project will increase significantly. Even before the latest ESA announcement, AMSAT-DL and AMSAT-NA were projecting a combined budget shortfall of about two hundred thousand dollars (US) in the money needed to complete their respective tasks on the project.

"This shortfall can only increase now as a result of this latest schedule change," said Tynan. Both AMSAT leaders urged everyone to continue doing as much as they possibly can to ensure the needed funds will be in place for the completion and launch of Phase 3-D.

From AMSAT news release, March 19, 1997.

CQC Top Ten Signs You've Been a Ham Too Long

10. You refer to the kids as "harmonics."
9. Every time you make a mortgage payment you think about what sort of rig you could buy for the same money.
8. Towers, yagis, and odd bits of wire in the air look "pretty."
7. Your car license plate has your callsign on it.
6. You use Q-signals in everyday speech.
5. Your first consideration in looking for a new home is where the antennas will go.
4. Your mobile rig is worth more than your car.
3. You refer to your kid's boom-box as a "rig."
2. You have jockey shorts with your callsign embroidered on them.

And the number one sign You've Been a Ham Too Long:

1. Two words: "dit dit." [*Ed. Note: A CQC inside joke—it's the trademark signoff of QRP guru K5FO.*]

From *Low Down*, official journal of the Colorado QRP Club (cqc@aol.com).

Repeaters: How They All Came About

Once upon a time, there lived a scattered group of persons who wanted desperately to talk with other persons who lived in the far away berry patches.

After much deliberation, they selected one of their clansmen who just happened to live atop a big hill and who had a big mouth—and excellent hearing. The one in the valley yelled remarks to the top of the hill, where the top man then repeated what he heard so that all listeners, everywhere, would know what was being said from here and there.

Now it happened that some individuals could not hear the voice from atop the hill in good fashion. Also, some of the traveling salesmen riding their donkeys in some distant valley remained unanswered because their voices fell upon empty air.

There were some souls in some geographical spots that had been taught to whistle just right before they yelled to the re-sayer. Unless he recognized a certain whistle, he refused to do any hollering for them.

All in all, it was a happy experience for most folks. In fact, it was suggested that the idea be put upon a stone tablet and preserved for posterity. It was done.

Author unknown; the *ARNS Bulletin,* April 1997, got this from the *SERA Repeater Journal,* December 1996.

What To Do About the Code

Amateurs are fascinated with coded transmissions. We bitch, moan and complain endlessly about the CW testing requirements forced on the Amateur community and then insist on using every CW "Q-code" known to man while working the local clear channel repeater.

I guess, to prove that you are a "real" ham, you must use as much "Radio Speak" as possible, but it does take a little bit of practice to become really proficient.

I just heard an OM on 2 meters going to QRX (he didn't say when). Often we will QSY to "you know, that other frequency" for private QSOs and, when we go home to the QTH after work the XYL will often force us to QRT at dinner time.

How often have you been QRM'd recently? Not to mention the constant problems with QSB and the fight with QRN in the summer. I never know when I am going to be QRX'd and I am never really sure of my QRY on the net. I never know the QTR (probably because I have two watches) and no one ever agrees with my QTB.

I hate guys (and gals) that QSK me and then are unable to QSL because they have not been QRV when I CQ.

The FCC encourages the use of phonetics as formulated by the ITU when encountering QRM or when signals are QRJ. The object of which is, of course to facilitate communications and avoid mistakes. This can be real fun depending on who is on the other end of the QSO. Since most of us don't bother to learn the current version of the phonetic alphabet (at least not all of it) the simple A-B-C-D can become:

Able, Baker, Charlie, Dog or... America, Bolivia, Canada, Denmark or... Alpha Bravo, Charlie, Delta... all of which, depending on your age, are, or at least were, acceptable phonetics.

Then there are those who must invent their own phonetics. When this occurs, N2VPN can become: Noah's-Two-Very-Peculiar-Nomads.

By John Buzby N2VPN in *Harmonics,* South Jersey Repeater Association, April 1997.

The Bones of the Organization

1. The *wishbones:* those who wish somebody (else) would do something.
2. The *jawbones:* those who talk about the problem, but do little else.
3. The *knucklebones:* those who knock everything—especially the backbones.
4. The *backbones:* those who carry the load, but usually don't say much.

What type of Bone are you?

Think about it!

TNX *ARNS Bulletin,* April 1997; *Collector and Emitter,* November 1996; *Counterpoise,* November 1994.

ATV is Here to Stay!

Getting started with amateur television.

Andrew C. MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083-5640

Amateur television, or just ATV, can refer to fast-scan TV that we see at home on the "tube," slow-scan TV that periodically produces a new still picture (depending on the format), or something in between. The transmission of images as digital files, via terrestrial or satellite links, can also be considered amateur television. But the real fun comes back to the *first* definition. Full-color, full-motion, fast-scan TV is gaining popularity and acceptance in the amateur community.

My first ATV experience dates to a period when HF transceivers had more tubes than transistors, VHF-FM was new to most hams, and to change frequency up there, you had to buy new crystals for the desired channel. Amateur television enthusiasts operated on UHF frequencies, above most "normal" ham activity. They had equipment that most hams couldn't recognize, understand, or afford. The ATVers of that day were either electronics design engineers, or worked in the TV broadcast business, or both.

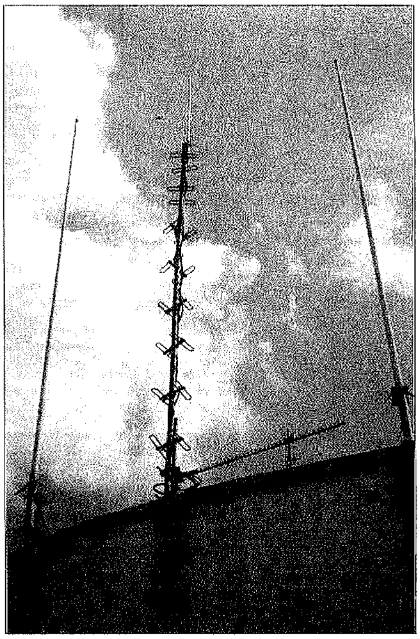


Photo A. *HATS ATV transmitter site repeater antennas.*

Home movies were made with wind-up or battery-powered 8mm movie cameras. Tape decks were for audio. Tripods were for film-type still cameras. Most TV signals were broadcast. Cable TV was rare, and satellite TV was little more than an expensive experiment.

Today's home movies are made using camcorders with tripod connections. New styles of electronic still cameras are coming out every day. Video cassette recorders are everywhere. Many have cable TV. Those who don't probably have cable-ready TV sets or recorders. Satellite TV systems can be purchased at the local mall or discount store. Times have changed, and so has ATV.

Getting started with ATV is much easier now. Many of the ingredients for a home television station may already be on hand. To make things easier, answers to frequently-asked questions can be quickly found on the Internet. In addition, there are magazine articles, columns and books about ATV, along with equipment manufacturers producing amateur television gear, ready for purchase, right off the shelf.

Ultimate simplicity

For those hams fortunate enough to have an active local ATV club running a well-located television repeater system, shifting a few wires in the shack may be all that's needed to receive ATV.

The local Houston, Texas, repeater (W5PZP) has a standard amplitude-modulated television output on 421.25MHz. This corresponds directly to cable channel 57. For those within a few miles of the repeater, signals can be received with a cable-ready TV set connected to an outside UHF antenna. The repeater transmitter is often commanded for continuous transmission of test patterns or information screens to facilitate testing of home and mobile receive equipment (**Photos A, B, C**).

For those who don't have a local TV repeater with output on 421.25MHz, there are alternatives. A nearby ham with an ATV transmitter can provide some video to test a simple receive setup. Most direct AM-ATV activity on 70cm occurs on 426, 434 or 439.25MHz. These frequencies correspond roughly to cable channels 58, 59 and 60. Home station transmitters are not generally used on 421.25MHz, due to the close proximity of the band edge at 420MHz. Suppression of the lower sideband components requires special filters, usually found only in commercial transmitters and better ham repeater systems.

The Houston Amateur Television Society (HATS) Web pages include a section describing "How to get on ATV CHEAP". Check out the Universal Resource Locator (URL) [http://www.stevens.com/hats/]. The suggested minimum system includes a simple 440MHz beam (the club sells an inexpensive kit), a mast-mounted preamp and a TV tuned to cable channel 57. With adequate height (outside and just above the roof), enthusiasts have been able to see the repeater out to 25 miles.

Many local OSCAR (Orbiting Satellite Carrying Amateur Radio) chasers

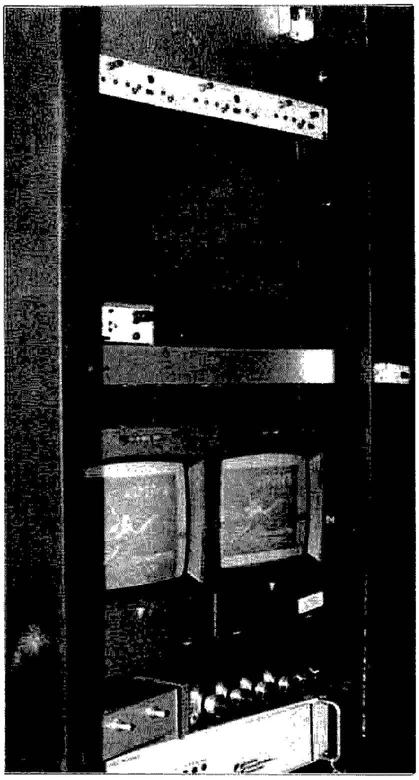


Photo B. Monitors and controllers at the HATS ATV repeater transmitter site.

have been able to use their 70cm satellite antennas to monitor ATV activity when the satellites are below the horizon. In addition to various ATV-oriented activities through the repeater, the Houston AMSAT net is carried on the local system.

The next level

Competition for spectrum within the amateur allocations continues to accelerate. ATV in Texas has not been immune to pressures from closed repeater and link systems in the 70cm band. For the most part, cooperation has won out over confrontation between the voice and video camps. While the audio-only link proponents have expanded into the traditional ATV 70cm spectrum, the video supporters have looked to higher frequencies for clear channels. The groups have worked together, to keep interference at a minimum for the 421.25MHz TV repeater channel, and to avoid the 435-438MHz satellite band.

The 23cm or 1.2GHz band is 60MHz wide. This bandwidth can support a lot of modes without conflict. The Houston group maintains an in-band FM television repeater on 23cm with an output on 1285MHz. This is the same signal that is transmitted on 421.25MHz AM, the preferred entry-level receive frequency.

While 1.2GHz television operation may at first seem to be a formidable task, only for radio and TV gurus, it is not. Many hams have put systems on line to receive 1.2GHz FM TV for less than $50. The methods are surprisingly simple, requiring no home-brew gear or design work.

The recent migration of satellite television viewers to K-band (12-14GHz) digital and subscriber systems has provided a surplus of older FM satellite receivers with inputs compatible with 1.2GHz ham television.

There are several types of satellite-TV receivers circulating on the ham swapmeet circuit. The one to look for is designed for the C-band (4GHz) or Ku-band (12GHz) LNB (low-noise block downconverter). The LNB is placed at the focal point of the satellite-TV dish. It amplifies the satellite signal and downconverts the 500MHz-wide passband to 950-1450MHz. This signal is typically fed through 75-ohm coax (RG-59 type) to the receiver. The receiver is tunable through the 950 to 1450MHz range, thus covering the 1.2GHz ham band, but is rather insensitive since it expects a rather strong signal from the LNB. Receivers of this type can usually be purchased for $30 to $70. The simpler, more inexpensive, receivers with analog tuning and few extras are easier to use for ham TV.

Getting one of these receivers on the air is simple: Add a preamp and a 1.2GHz beam antenna. The FM-TV signals broadcast by the TV satellites are typically wider than those used by amateur TV systems. Simply increasing the receiver's output video level will provide a quick fix.

Transmitting

While getting something on line that can receive signals from a nearby ATV enthusiast or repeater can be easy, transmitting TV is more challenging. Even if all the gear is purchased, rather than home-built, attention to detail is imperative. At 70cm and 23cm, RF connectors, cable and antenna quality is key. Most ATV stations incorporate "N" connectors, low-loss coax like Belden 9913 or better, and high-gain antennas. At 1.2GHz, even a 100-foot run of 9913 will lose up to 75% of the signal. Many stations with runs this long have gone to 7/8-inch hardline, or remote power amplifiers. Check the specifications, and buy the best you can afford.

ATV is a very unforgiving mode. If the path between two stations will support narrowband FM UHF communications at 40 to 50dB over S-9, TV will probably work. Trees and buildings can cause multipath problems, or ghosts, or may even prevent communication completely.

There are several sources of ATV transmitter gear. A few of the more well-known companies include HF Technology, (847) 639-4336; PC Electronics, (818) 447-4565; Pauldon Associates, (716) 692-5451; and Wyman Research, (317) 525-6452. Most also carry receivers, receive converters, preamps and antennas. Clubs like HATS have taken the initiative to design and build kits for antennas, preamps, filters and transmitters. This provides the club with funds for repeater repair and upgrades, while at the same time allowing members to get on the air for less money and to learn more about TV technology.

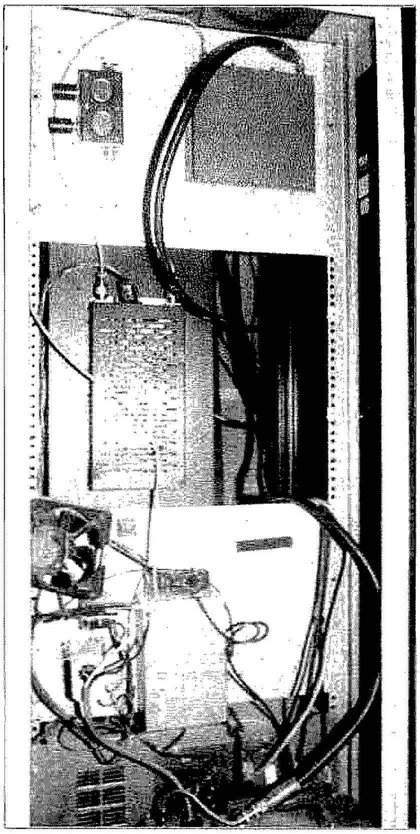


Photo C. Power supplies and amplifiers at the HATS ATV repeater transmitter site.

Why ATV?

Interactive television is an intense mode. Unlike typical voice communications, where you can monitor a conversation from the other side of the room while soldering a circuit together, ATV requires your attention. To participate in a "conversation," you must watch and listen. When transmitting, you may be running tapes, displaying devices in front of a camera, or trying to get a computer screen to look right over the air.

It's also not something that you do while mobile. In fact, it can be quite dangerous. A few hams in Houston have managed to rig cameras and transmitters that can run without intervention while driving, but they rely on the signal reports from monitoring stations to make any adjustments. It's illegal for drivers in many states to have a TV set in viewing range. Most ATV is done while at home, or at least from a stationary position.

After you've shown off the kids, dogs, cats, all the stuff in the shack and all the old home movies, what's left? The answer is only as good as your imagination. The South Texas Balloon Launch Team has been using ATV for many years to transmit live television back from altitudes over 100,000 feet (**Photo D**). The HATS group televises club meetings and license-upgrade classes around Houston. Unlike commercial broadcast television, ATV is two-way. Stations can "talk back" to the class or club meeting with either two-meter FM or their own live television.

HATS members also enjoy volunteer activity during community activities that use TV coverage for event coordination. Each year the members go to the streets to transmit live TV from the Houston Methodist Marathon and the March of Dimes Walk America (**Photo E**). As the club grows, so does the potential of the group to cover more events and provide useful public service. While event officials see live action along the course route, so do hams around town. Some experimenters use ATV on radio-controlled airplanes and cars, while others have even launched ATV in very large model rockets.

Due to the unforgiving nature of ATV, most hams pursuing this mode are constantly upgrading their equipment. More power, bigger antennas, and better feedline are primary targets. Station enhancements can include more or newer cameras, better lighting, video/audio switch boxes and

***Photo D.** HATS member Rick Pense WD5BQN prepares for 1.2GHz ATV reception of a South Texas balloon launch.*

VGA to NTSC converters to get computer images on the air. While ATV stations used to keep old ham license plates around for video identification (ID) screens, new inexpensive video titlers have taken over. Experiments with remote-controlled cameras and transmitters are also fun. In addition to activity in the 70cm and 23cm bands, efforts on higher frequencies past 10GHz are not uncommon. ATV is a good place to learn advanced RF techniques. You can "see" the results.

Finding out more about ATV is easy. A look at the Internet can get things started. In addition to the HATS Web page at [http://www.stevens.com/hats/], *Amateur Television Quarterly* Magazine (ATVQ) maintains pages via the same provider. Check out ATVQ's page at [http://www/stevens.com/atvq/]. Both HATS and ATVQ provide many links to clubs, manufacturers and distributors around the world. While at the ATVQ site, note that a magazine subscription form is part of the home page. ATVQ comes out four times a year and offers a fine magazine dedicated to the pursuit of amateur television. Henry Ruh KB9FO, the publisher, also offers an array of books and other publications. A very popular two-volume publication from ATVQ provides history, tutorials and technical information about amateur television. The first part is called *ATV Secrets for Aspiring ATVers* ($9.98). The second volume is much larger and is simply titled *TV Secrets Volume II* ($24.95). Henry and ATVQ can be contacted via phone at (219) 662-6396; FAX at (219) 662-6991; or by mail: 3 N. Court St., Crown Point IN 46307.

You will find articles covering many ATV construction, operation and information topics, including Bill Brown WB8ELK's ATV column in *73*. Bill takes on timely issues with insight on the latest gear and activities in this specialized niche of amateur radio.

I hope you get started with ATV soon—and *see* what you've been missing!

***Photo E.** HATS members John and Stuart Ross provide live coverage of the Houston Methodist Marathon via ATV.*

How to See What You Hear

WARNING! This is easy!

Ron L. Sparks KC5ODM
24818 Lakebriar Drive
Katy TX 77494-1809

Anyone can bypass the hurdles and jump right into having fun with ATV. The good news is that very few ATVers feel threatened by anybody, so getting started is really easy! Notice that I said "threatened." Our hobby is plagued by two problems which make it unnecessarily hard for newcomers. Some readers may be offended by my assessment of these problems, but my objective is to make it easy and interesting for people to try out amateur television (ATV). I am not necessarily trying to be "nice." By being aware of the problems, things will be easier for newcomer and Elmer alike.

Both these problems arise from our strengths, so let's be honest about them. First, the strength and reliability that comes from a spread-out, redundant, self-healing organization causes information to be scattered and disorganized. Second, the technical expertise and practical know-how that create a unique membership often cause "outsiders" to be forced through barriers designed (subconsciously, I hope) to protect the "insiders."

If you want to test the second point, just pick a fight between the "outside" and the "inside" by honestly asking, "Why?" Then sit back and listen. A simple equation can be used: The volume and duration of the ensuing argument equals the strength of the threat the "inside" defenders feel. Typically, the more threatened they feel, the more arbitrary and difficult the hurdles to joining will become.

Five simple steps

1. Develop curiosity: The first step is to decide you are interested and begin looking at your options. The particular ATV avenue you choose to explore depends on your personal interests. Do you want to help a specific charity or organization with your skills? Do you want to aid in emergency response? Do you want to create a different view of the world by seeing from the level of your pet, your radio-controlled model, or the top of your antenna tower? Do you want to monitor some area remotely? Would you like to have a "looky talky"? Would you like to create a network of mobile cameras for traffic monitoring? Do you want an inexpensive way to experiment with microwaves? Are you wanting to try something really exotic like ATV via satellites? Do you want to see what the other ham is talking about?

2. Finding where you are: The next step is to find out where you are—in both a physical sense and from an equipment standpoint. One sidebar is a list of areas with activity in ATV. All of these areas are shown to have ATV repeaters and the list is growing daily. If you are not in an area covered by a repeater, do not give up. There is plenty to do even without repeater access. While you are checking the activity in your area, don't forget your local ham clubs. Most of the people in these clubs are willing to point you toward others with similar interests. There are even some clubs which are specific to ATV. In the Houston, Texas, area, HATS (Houston Amateur TV Society) is very active and devoted entirely to ATV. If you are already licensed, you have probably made the necessary contacts through the testing process, existing club, or local repeater. You just need to ask them about ATV.

If you are not yet licensed, this is where the first principle I mentioned earlier becomes a difficulty. It is often hard to find a club if you do not already know of one. Most clubs have a limited budget and operate by volunteer efforts. As a result they have limitations on how much general publicity they can do. A way to find them without Internet access is to contact the ARRL at 1-800-32 NEW HAM (800-326-3942) and ask them for contact information on Volunteer Examiners (VEs) in your area. These VEs will almost always be connected with a local club. They will also be interested in explaining how to go about getting licensed. By attending one or two club meetings, you will make the contacts you need to find the ATVers in your area as well as other ham information you may be interested in. If you are new to a club (even if you are not new to electronics or ham radio), be prepared for the second principle I mentioned to rear its head. Many club members have been in the organization for a long time and they forget how intimidating a room full of stony-faced strangers can seem to a newcomer. Just keep in mind that they enjoy the same thing you do or they wouldn't be there. Don't take the "I thought everybody knew that" comments as personal. They've been doing it so long, they really think everybody *does* know. A few honest questions will almost always open them up. One final tip: A wise friend told me, "Repeaters and ham clubs are a lot like your local bar or pub. Each has a different character of clientele. Move around until you find one that matches your personality—before long it will seem like a comfortable shoe."

Licensed or not, another good way to find ATV activities is by an Internet search. Increasing numbers of clubs and

individuals are putting up Web sites. The thoroughness of this resource is improving rapidly. Two Uniform Resource Locators (URLs) that are good starting points are the HATS home page at [http://www.stevens.com/HATS/home.html] and the Southern California (WA6SVT) ATV repeater page at [http://web.io-online.com/users/forsberg/atv.htm]. These pages have links to alot of ATV information and activities. The link pages can be reached from the above URLs or directly at [http://www.stevens.com/HATS/sites.html] and [http://web.io-online.com/users/forsberg/links.htm] respectively. If you're in need of general ham information or lots of links to good ham-related sites, you might want to try starting at [http://www.clarc.org/] or for those of you interested in what's going on in Europe, try [http://www.innotts.co.uk/~asperges/index2.html].While there isn't much in the way of ATV-specific software, the famous Oakland site is a wealth of ham-related information. You can enter at the ATV directory by using [http://oak.oakland.edu/pub/hamradio/dos/digital/atv/]. Just click on "Parent Directory" to move up and explore the whole ham radio tree. There is a file index at the HAMRADIO directory. Now that you know where the people, repeaters, and software are, it's time to jump in.

3. Planning where to go: The absolutely cheapest means to try out ATV is with a Receive-Only (RO) setup if you live within 25 miles or so of a repeater site. Most of you probably already have all the equipment and know-how it takes. **Table 1** shows that the 70cm ham band, often used for repeater output, can be received on cable-ready TVs or VCRs. Check the repeater directory or with your local club, and see if they are on one of the channels shown. If so, you can rig up an RO setup in 15 minutes. Just connect a good UHF antenna to the antenna input of your cable-ready set, but put it in the Cable-Ready mode. Then tune to the proper cable channel and you should see the repeater. Some people in the Houston area are even able to do this with rabbit ears! One note, however: Cable converter boxes will probably not work in this application. They are generally designed for the high-level signal from the cable and are not sensitive enough to work with an antenna.

You may need to experiment with whether to place the antenna horizontally or vertically. This depends on the repeater antenna polarization. Here in Houston, the output is horizontal and the input is vertical. That may be pretty common because it allows normal yagi or TV-style antennas to be placed normally (i.e., parallel to the ground) for receive. The transmit antenna back to the repeater can then be a vertical whip (great for mobile use).

But what about the antenna? That's not a problem either. The antenna can be a surplus UHF TV antenna, or you can build your own. I went the simple route and bought a kit from HATS for $15. Assembly took 20 minutes. It's giving me snow-free pictures even though it's mounted inside my attic and located 24 miles from the repeater. That $15 represents my *total* investment in getting started.

4. A piece at a time: The thing to remember is that this is a hobby. The fun is in the *doing*, not so much in the finishing. ATV is a great way to enjoy this hobby because it lends itself to little steps. For example, once you're receiving the local repeater you'll want to participate in any nets held there. This will usually take only a 2m handie-talkie (HT). There are now quite a few of these priced under $200 new. The local AMSAT Net is held here in Houston on 2m and is simulcast on the HATS ATV repeater. It is a real improvement to get to watch the net rather than just listen.

The addition of the 2m rig allows access to the control functions of the ATV repeater, letting the newcomer experiment with switching cameras, changing audio input, etc. Once you're comfortable with this, you will want to get on the air. A cheap way to experiment is to locate a source for the Rabbit™ transmitters that were frequently offered at discount department stores.

The early variety of units operated in the 900MHz ham band, and will allow you to experiment with different antennas, camera types, audio mixers, titlers, and other aspects of ATV. A camcorder is a readily available input device. Many older camcorders, especially ones with broken tape mechanisms, can be found at garage sales, pawnshops, and repair facilities almost for free. Photo supply mail-order firms often have very good prices on simple titlers.

Cable Channels in the 70 cm Ham Band

Cable-Ready Tuner Channel	Lower Edge of Band (MHz)	Upper Edge of Band (MHz)	Video Carrier Frequency (MHz)	Color Subcarrier Frequency (MHz)	Sound Subcarrier Frequency (MHz)	Cable TV Band Name
57	420	426	421.25	424.83	425.75	Hyper
58	426	432	427.25	430.83	431.75	Hyper
59	432	438	433.25	436.83	437.75	Hyper
60	438	444	439.25	442.83	443.75	Hyper
61	444	450	445.25	448.83	449.75	Hyper

***Table 1.** Cable TV is on the ham bands.*

When you feel comfortable with these aspects, you can jump up to repeater input. Things may be a little different for those repeaters with 420MHz or 900MHz input, but the principles will be the same as you need for the 1280MHz repeaters. One of the big advantages of the higher-frequency inputs is the smaller size of the antennas required.

5. Keep it up: The last step is the real key. As you can see from step four, the possibilities are limited only by your imagination and desire. As with any new endeavor, you must keep looping back to the curiosity step, then progressing forward with a new aspect or component. This loop is the source of the fun and amazement that ATV can generate. Nothing keeps you from going down several paths at once, either. Right now I am building a 1.296GHz version of the Kent Britain WA5VJB antenna to hook to the HATS arrangement shown in **Fig. 1**. I

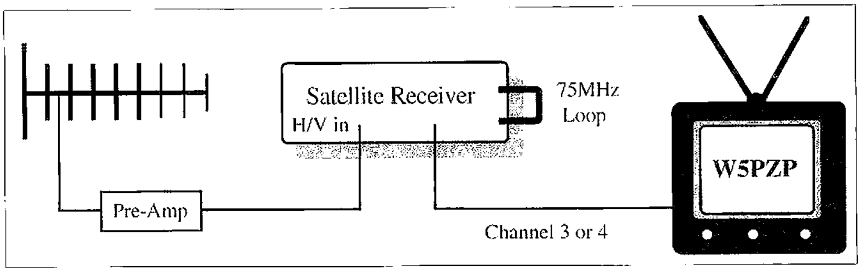


Fig. 1. Microwave ATV on the cheap.

Glossary of Common ATV Terms

ATV	Amateur television is often called ATV. Most often this means transmitting and receiving video and audio at normal speed. Sometimes called Fast Scan TV (FSTV).
Cable Box	A cable box is a set top converter which allows signals outside the normal broadcast band to be downconverted to channel 3 or 4 for viewing on any TV. These are not usually sensitive enough to be used in ATV.
Cable-Ready	A cable-ready tuner on a TV or VCR is designed to pick up signals outside of the normal broadcast band.
Composite Video	A composite video signal is one which contains the base band video with the proper (i.e. NTSC, PAL, SECAM, etc.) synchronization pulses and color information. This will typically have a voltage peak of about 1V and a bandwidth of 4.5 to 6 MHz.
Downconverter	In tuning the ATV frequencies on a regular TV some form of down conversion is required. While this may sound complicated to a newcomer, it is probably built into sets that are cable-ready.
DSB	Double Side Band is an extremely simple mode used for most microtransmitters. It is also wasteful of band and power. In all but the least expensive or smallest transmitters, the lower sideband is filtered out with a Vestigial Sideband (VSB) filter. Modern TVs will receive a DSB signal just as well as a VSB signal due to filtering in their IF sections.
FSTV	Fast Scan Television is a synonym for ATV. It implies that the transmitted frame rate and scan speed are the same as those of an international standard.
NTSC	National Television System Committee is the group that set up the way TV is broadcast in America. Because of its vacuum tube heritage, it is often jokingly taken to mean "Never The Same Color" from the way color is encoded. The picture is transmitted at 59.94 fields per second with two interlaced fields of 262.5 lines making one frame. The line rate is 15.734 kHz.
PAL	Phase Alternating Line is the TV standard for broadcast in the UK, Central Europe, Scandinavia, Asia, Australia, and much of South America and Africa. It comes in several "flavors" such as PAL-I which affect the way the sound subcarrier is transmitted. The UK uses PAL-I. The picture is transmitted at 29.94 fields per second with two interlaced fields of 312.5 lines making one frame. The line rate is 15.625 kHz.
SECAM	*Sequentielle Couleur Avec Memorie* is the French-originated TV standard that is used in France, Eastern Europe, Russia and the former Soviet states.
VSB	Vestigial Sideband filters are used in the transmitter to eliminate the lower sideband component. As with Single Sideband (SSB) phone transmission, this is the most power- and spectrum-efficient means of transmitting the signal. The main difference between a VSB and an SSB signal is that the carrier is still present in the VSB signal while it has been removed from the SSB signal.

ATV Activity Hot Spots

State or Country	Web Page	City or Region
Alabama		Numerous areas
Alaska		Fairbanks
Arizona	Yes	Pinal Peak and Phoenix
Arkansas		Little Rock, Harrison, Heber Springs, Russellville, Pine Bluff
California	Yes	Numerous areas
Canada	Yes	Numerous areas including Calgary, Winnipeg, Ottawa, Montreal, Regina, Saskatoon
Colorado	Yes	Numerous areas including Boulder, Colorado Springs, Denver
Delaware		Wilmington
District of Columbia		Alexandria VA; Rockville MD
Florida	Yes	Numerous, some NASA-related
Georgia	Yes	Atlanta, Dalton, Savannah
Germany	Yes	Numerous areas including Cologne and Lower Rhine/Dutch Border
Great Britain	Yes	Numerous areas including East Sussex, Kent, West Devon, and Coventry
Illinois		Decatur, Champaign, Des Plaines, Galesburg, Peoria
Indiana		Numerous areas
Iowa		Davenport, Des Moines, Dubuque
Kansas		Kansas City, Topeka, Wichita, Pittsburgh
Kentucky		Bowling Green, Elizabethtown
Louisiana		Baton Rouge, New Orleans, Shreveport
Maryland	Yes	Annapolis, Baltimore, Rockville
Massachusetts		Boston, Leyden, Springfield
Michigan		Ann Arbor, Saginaw
Minnesota		Minneapolis-St. Paul
Mississippi		Gautier
Missouri		Columbia, Kansas City, Joplin, St. Louis
Nebraska		Grand Island, Lincoln, Omaha
Netherlands	Yes	Arnhem, Eindhoven, Soest, Ulft
Nevada		Potosi Mountain
New Hampshire		Derry
New Jersey	Yes	Brookdale, Moorestown
New York		Ithaca, Finger Lakes
North Carolina		Charlotte, Greensboro, Shelby
North Dakota		Harwood
Ohio	Yes	Numerous areas including Columbus
Oklahoma	Yes	Oklahoma City, Tulsa
Oregon	Yes	Portland
Pennsylvania	Yes	Numerous areas, Carnegie Tech
Puerto Rico		East
Rhode Island		Providence
South Carolina		Lexington, Sumter
Tennessee	Yes	Numerous areas including Johnson City and the Tennessee Valley
Texas	Yes	Numerous areas including Abilene, Austin, Beaumont, Dallas, Houston, The Woodlands, Clear Lake, Midland, Tyler, Waco
Utah	Yes	Salt Lake City
Virginia		Numerous areas
Washington	Yes	Western Washington
Wisconsin		Numerous areas

have also put together a 7-ounce micro-ATV system for launch in my brother's model rocket. You could be having as much fun as we are! This is one facet of the hobby where I can officially close with "I'll be seeing you."

References

1. "Fast-Scan Television," *The ARRL Handbook for Radio Amateurs*, 73rd Edition.

2. Ruh, Henry KB9FO, "The Nature of Video," *CQ VHF - Ham Radio Above 50 MHz*, March & April 1997.

3. Garcia, Fernando, "A Beginner's Guide to World Wide Television Standards," *Nuts & Volts Magazine*, December 1996.

4. Valkenburg, Mac E., *Reference Data For Engineers*, 8th Edition, Butterworth-Heinemann, 1993.

5. "Amateur Television," *The ARRL Repeater Directory*, 24th Edition.

6. [<http://www.users.interport.net/~ jbay /theatre-sound/tv-2.html>]. This file has some very good information and was used to cross-check the Hyperband Cable frequencies, but it appears to have a minor error. When compared to Reference 4, above, the frequency stated as "Picture Carrier" in this table is, in fact, the lower band edge. The "Picture Carrier" or Video Carrier would be +1.25 MHz from this edge, not -1.25.

7. Britain, Kent WA5VJB, "Cheap Antennas," *Houston Amateur Television Society Flyer*, HATS, Inc., 13054 Pebblebrook, Houston TX 77079, 1997.

C-Band Low Noise Amplifier

Use discarded satellite receiver parts to soup up your ATV system.

Rick Pense WD5BQN
1511 Brickarbor
Houston TX 77449
E-mail: [WD5BQN@stevens.com]

In keeping with the amateur tradition of using the cheapest means possible to accomplish results, I have assembled complete 1.2GHz receive systems from old satellite receive equipment. The desired satellite receivers are known as block downconverted receivers. In their original implementation, they act as a tunable IF strip. The frequencies that they are designed to tune are 950MHz to 1450MHz. This makes them excellent candidates for use as receivers in our 1.2GHz FM ATV band. The front end of these receivers is very broad, so simply attaching an antenna to them usually gives poor results—you're weighed down with reception of broadcast TV signals, paging transmitters, cell phone intermod, and other signals. Also, they aren't usually very sensitive, so you have to add some type of preamp to bring the received signal up to the input level the receiver wants to see.

The first problem, that of the undesired signals, is cured by using a waveguide transition made from coffee cans as an antenna. The design for this feedhorn is available in various books and magazines, but it's simple enough to run through right here. Solder two 34.5-ounce coffee cans together so that only one end remains sealed. Place a type-N connector with a two-inch #14 wire soldered to the center pin three inches from the sealed end. You now have a 10dB "cantenna" to use in front of your receiver.

The hardest part of this project was the preamp. High-gain, low-noise preamps for use at 1.2GHz are not cheap. I found a solution in an old copy of *73*. C. L. Houghton WB6IGP, in his "Above and Beyond" column (May 1993), described a conversion of old satellite LNAs (low noise amplifiers) for use as preamps on spectrum analyzers. These LNAs were used on the earlier-style TVRO satellite systems and they were designed to pass 3.7 to 4.2GHz. His instructions to cut the horn feed off and attach a type-N connector are okay if you've been around microwave equipment for a while, but I think it's time to give a more detailed description so that others can enjoy the kind of fun we're having here in Houston.

"We just ask homeowners with incorrectly-aimed dishes if we can have the LNA."

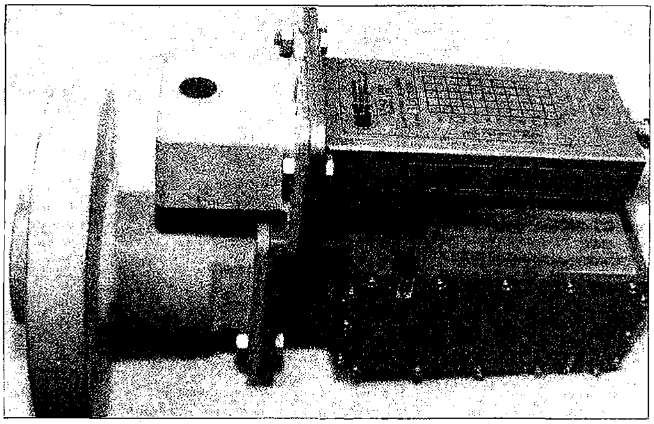


Photo A. *Two LNAs and a two-axis feedhorn, hot off a satellite dish.*

First, find an LNA

The LNA is easily identified by the type-N connector on one end. We have a lot of luck finding these LNAs around Houston: We just ask homeowners with incorrectly-aimed dishes if we can have the LNA, if they aren't using the dish (see **Photo A**). Sometimes the owner says yes, but only if we take the dish—which is fine—these dishes perform well at 1.2GHz. I have a six-footer on my van, with a cantenna feedhorn, which has worked our repeater from numerous special events locations.

Place the LNA in a vise and carefully cut off the waveguide input section, leaving an area to mount the type-N connector (see **Photo B**). Remove the screws which hold the cover on the preamp. If a circulator/isolator is in your preamp, it must be removed. Look around inside the preamp to see how the unit was originally assembled. It may be necessary to remove all the screws and unsolder and remove the type-N connector to get the isolator out. The isolator must be removed as it is a narrowband device and we are moving

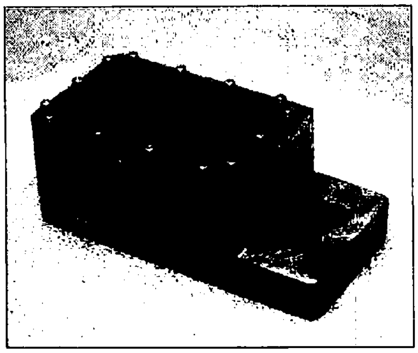


Photo B. Waveguide has been sawed off.

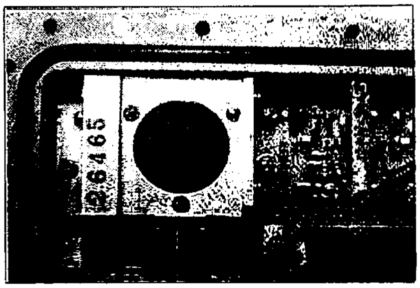


Photo C. Circulator to be removed.

Photo E. Comb filter to be removed.

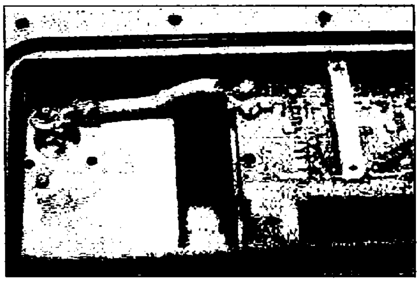


Photo D. Circulator removed and coax installed.

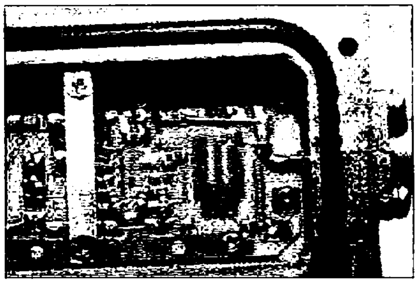


Photo F. Comb filter bypassed with wire jumper.

the designated passband down quite a bit (see **Photos C** and **D**). With the isolator removed, reassemble the preamp and mount a type-N connector near or in the hole where the original 3.7GHz waveguide probe was. Use either mini hardline or double-shielded mini coax to connect the type-N connector to the preamp's input. When you place the connector and its mounting be sure it's sealed watertight, because the LNA was designed to be mounted outdoors, and it'll take a beating from the elements. Both the center conductor and the shields of the coax must be attached to prevent oscillation of this very high-gain device. These units have an advertised gain of 40dB, and we have measured one device which had 60dB of gain with a 2.5dB noise figure after modification.

At the other end of the preamp, a comb filter may be included to limit the passband of the preamp. Removal of the filter is accomplished with a hobby knife. Only the tips are left, and a wire jumper is installed across them to try to keep stripline integrity (see **Photos E** and **F**).

You tweak the amp (if necessary) by removing or relocating blocking capacitors on the striplines. Older-type amps have two blocking caps on the microstriplines which decouple the stages in the preamp. Removal of the capacitor nearest the GaAsFET electrically lengthens the microstrip, lowering the operating frequency. Be careful to prevent oscillation, as these are very low-noise, high-gain GaAsFETs in these amps. Generally, amps with five or more active devices should not be tweaked. Amps with three or four stages can be heavily massaged to lower their operating frequencies. Coupling capacitors between stages can be increased to aid low frequency response. Usually, while tweaking, I will simply add a capacitor beside the original in case removal is required later. Tweaking is a trial-and-error approach, and should not be a substitute for proper preamp design.

When completed, the modified preamp is a gain-block type of device. It should be very broadband, very sensitive, and fairly quiet. Use on other bands or modes is possible—Phase 3D comes to mind. The same requirements for frequency selectivity mentioned about the satellite receivers apply to these LNAs. Some type of frequency-selective filtration must be applied in front of the amp. Use of a commercial 1.2GHz yagi directly into the preamps was unsatisfactory.

We've had some success in Houston with a two-cavity filter which allows full duplex operation on 1.2GHz. Separate antennas and careful placement are required. We transmit on 1.255GHz and receive on 1.285GHz. The use of these satellite receivers, only 30MHz removed from 18W transmitters, has proven them a practical substitute for much higher-priced commercial FM ATV receiver systems.

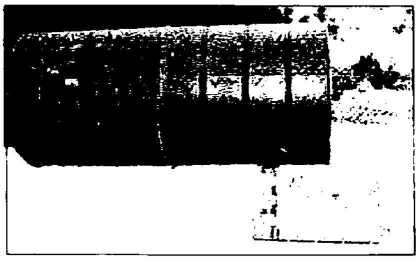


Photo G. Cantenna and preamp ready for service.

Video Titlers for ATV

If you're serious about ATV, a video titler is the way to go.

Fred Juch N5JXO
13054 Pebblebrook
Houston TX 77079
E-mail: [N5JXO@stevens.com]

In the 10 years I've been involved in amateur television, I've used just about every type of station video identification scheme possible. I began with an old Vidicon camera with an on-screen titler. I've used posterboard in the station background. I have even tried CGA computers to generate the proper ID screens. All work fine, but...

A video titler will overlay your video screen with text information. Similar to national news broadcasts, you can put your ID in the corner of the screen, or you can use scrolling or crawling text. The units reviewed here are the low end of the current consumer market. They are intended for home video editing or adding titles to home movies. If you put a video titler as the last device in the video line before your transmitter you will always be able to send your ID independent of your video source.

You can spend hundreds of dollars (the Videonics Titlemaker 2000 runs about $650), but the three most popular (in the ham community) titlers under $150 are the Sima ColorWriter Magic ($139.95 at this writing), Sima ScreenWriter ($99.95), and the Ambico V-6350 ($119.95). All are available via mail order.

They have very similar features and performance. All have memories, can crawl text across the screen (right to left), and scroll text up the screen. They differ in the number of colors, amount of memory, and font sizes. I know hams active in ATV using all four titlers mentioned above and each would tell you theirs is the best for their specific application.

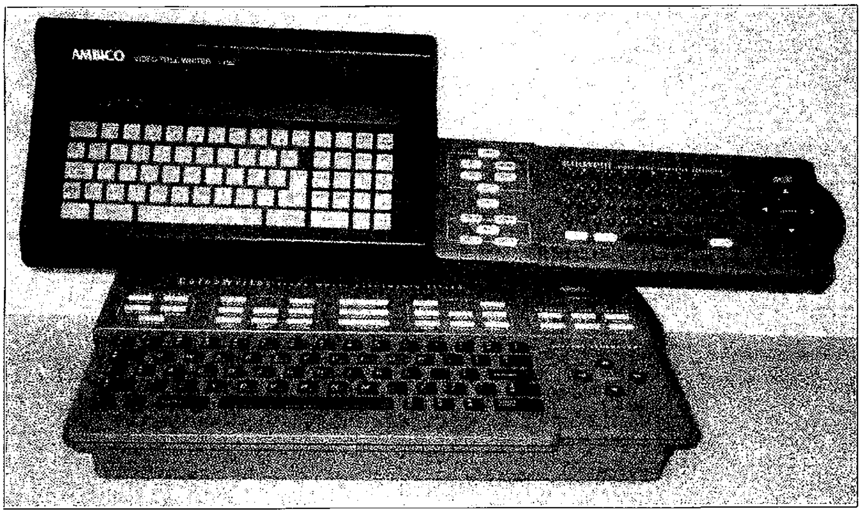


***Photo A.** Video titlers come in different shapes and sizes.*

All three titlers evaluated below run on 9 volts DC from a wall transformer. Each has a 7805 voltage regulator inside, so they should run off 13.5 volts if you take care to add a heat sink to the internal regulator (for portable use). The keyboards have rubber keys, and support special characters for international languages. All are in plastic cases although the Ambico V-6350 has a metal baseplate (the heat sink is not connected to that plate, however). S-video inputs and outputs are also standard on all but the ScreenWriter, and the Sima units are available in PAL as well as NTSC models.

I bought and/or borrowed each of these titlers, and evaluated them to find the best features of each. All operated as the manual said they should. After getting familiar with each unit I was able to quickly create ID screens and use the special effects like a professional. Here is an in-depth look at each unit and how it operates.

Sima ColorWriter Magic

The ColorWriter Magic is the largest of the titlers, measuring 13.75" x 8.5" x 2.5" high. It has 13 screen memories, a standard-size keyboard, and boasts eight colors. For battery backup of memory two LR44 button batteries are included, and are stated to last six months. This is the only unit (of these three) with a full size keyboard, so there is a lot of empty space in the unit for home-brew projects. (Maybe a VOR timer circuit?) The ColorWriter treats text and special effects separately. The only data in

memory is the text and color data. To create output the operator selects the page of memory, then what effect is desired, then "Insert." The last two screens of memory are reduced text pages and are used with the zoom feature. One page is a Headerline that can be displayed along with any other screen. The Headerline is great for putting your callsign on screen, while you scroll through other information simultaneously.

The colors (black, red, green, yellow, blue, magenta, cyan, white) are selected on the special section on the keyboard labeled "Color Select." There are five variations possible with these colors, including colored letters, boxed letters, bordered letters, reversed letters, and colored background. The boxed letter looks like a square of any color, with the letter in it, also of any color. Bordered letters are letters of one color outlined with another color. I usually outline with black for clarity. A neat trick this unit will do is reversed letters. That's not the same as backwards letters—if you select a color, then select reverse, the outline will be the color selected and the letter will be transparent—a neat effect for a callsign. All six colors are available in any combination.

When you select a memory location, then press "Create," the screen fills with small squares for editing. You can select colors, background, etc., and then start typing. The special colors can be edited later, one character at a time. The biggest annoyance is the lack of word wrap. You have to hit return at the end of each line. If you edit a page you may have to retype the entire page to add text at the top of the page. The editing keys allow you to adjust one of four character sizes for the entire page only; one of four scrolling speeds; and basic move/add/delete functions.

The insert keys allow the basic functions of inserting your screen on top of the selected video. You can do this in several ways. One function is fade in or out. Others are the scroll-up screen, and scroll across the bottom of the screen. Two of the memories support a zoom feature. This stunt is so crude it should not be considered a feature. It places text in the center of the screen, then enlarges or reduces the font size to simulate zooming in or out, but the font sizes are not proportional, and the results are awkward.

The special effects section of the keyboard allows you to move text onto or off the screen in one of six special ways:

- The entire screen can be brought into view from the right side of the screen.
- Alternating lines can be brought onto the screen from opposite sides of the screen.
- Lines can be brought onto the screen from the right, one line at a time.
- Text can be scrolled down the screen from the top.
- Text can be entered as if typing on the screen, one character at a time.
- Text can be scrolled up from the bottom. This is the best feature of the special effects section of the keyboard, as it makes text exit as well. For example, you can make the text enter from opposite sides of the screen. It will stop when text is all on-screen. You can then select "scroll up," and the text will slowly move up the screen until it is gone. The horizontal motion moves in jumps, one character space at a time, but the vertical scrolling is very smooth.

The ColorWriter is very versatile, and has enough features for creative ATV use. The colors can be mixed to produce exciting and brilliant on-screen text. The drawbacks are no flashing characters and only one available font. The special features will appeal to anyone who will be using this unit to put titles on tape for later viewing or transmitting. I also found the special effects fun to play with while transmitting over the local ATV repeater.

Sima ScreenWriter

The ScreenWriter is the smallest titler, measuring in at 11.5" x 4" x 1.5" high. The memory is backed up with a single CR2025 or CR2032 battery, and should last one year before replacement. It also has 15 memories, three of reduced size that are reserved for the Zoom feature. Also the ScreenWriter only puts out white text. This unit does have a demo mode that is activated by pressing the "Down" key after you power on.

This unit is operated like the ColorWriter discussed above, with a few exceptions. The unit cannot create a backdrop to put text on; you must have a video source connected to use it. The text can't be set on a block background, outlined, or reversed. There is one font, with four font sizes, so the keyboard is very simple and straightforward.

- Create: In the create section of the keyboard you have keys to select page number, font size, and the editing functions (add, delete, line shift). These will allow the entry of data into the memories for later viewing.
- Insert: The insert keys allow a memory screen to be displayed over incoming video. The limited functions available are Zoom In, Zoom Out, Scroll Up, Scroll across the bottom of the screen, and Cut in and Cut out. One amazing discovery is that the Zoom feature actually works! And it works on Zoom in and Zoom out. The reason it works is that the fonts are more proportional than on the ColorWriter. Only memories 13-15 can be used with the Zoom feature.

The ScreenWriter can add a callsign to a screen very nicely, for a small unit. It can also scroll text across the bottom of the screen, or up the screen. I think of this unit as a good tool that will get the job done, but with no bells or whistles. I also missed the Headerline feature available in the ColorWriter. If you are going to attach a unit to the handlebars of your bike, or on a portable camera, this may be the unit for you.

***Photo B.** Sima ColorWriter screen with Charlie Keng N5XGW (right) shows Headerline at top with larger size text in center, all outlined in black.*

Ambico V-6350

The Ambico is a slim 10.5" x 6.5" x 2" high and has 10 pages of memory; for battery backup of memory, two AA batteries are needed. The V-6350 can generate eight colors, but only four at a time.

The Ambico V-6350 has an adjustment knob on the back to set the width the image takes up on the screen. This allows the text width to be set so that it stays in the screen's viewable area. The "Mode" key is used to select how text is entered, manipulated through the use of special effects, and displayed or played back. This unit, like the ScreenWriter, has a demo mode to help you learn what can be accomplished with the titler, but the philosophy here is a little different. The memory not only holds the text, but also holds all the text manipulation information. This is very similar to making a small movie containing information and actions.

• Edit: To start entering text, first select "Page," then 0 through 9. Now choices can be made by selecting options on the edit screen. The background can be video, or solid white or black and is selected with the "Background" key. The flashing cursor indicates the color of text to be entered. Pressing "Color" will select one of the four colors shown in the color selection boxes on screen. Pressing "Shift" *and* "Color" will allow changing the colors in the four color-select boxes. The end result is that only four of the possible eight colors can be used on any one screen. Size is set for each line individually, and has four settings.

The text borders can be set to solid-color, color-filled outline, or hollow outline (transparent characters). Two fonts are available: one called normal, and one called narrow. The narrow font has only upper case characters. Unlike the other units mentioned above, the V-6350's characters can also be set to flash.

• Effects mode: After the text is created (in edit mode), pressing the mode key moves the unit to effects mode. There are four ways text can be brought on screen: cut in; scroll in; crawl along the bottom of the screen; and wipe in. Wipes can be from top, bottom or center of the screen. A delay of up to eight seconds can be included before the text exit effect is performed. The exit effects are: cut; scroll out; and wipe off. Again, wipes can be: from top and bottom; from the bottom; and from the top. Three speeds can be selected with most effects. One caveat, however, is that the V-6350 can't scroll in and scroll out on the same page.

• Active mode: To play back the text, the "Mode" key is pressed again to reach "Active" mode. Here the memory pages can be played back like small movies, individually, or in an automatic mode that goes sequentially through the pages.

The Ambico V-6350 does a good job of putting color text on the screen. The playback mode allows pages to be played back in a smooth predetermined method. The small size makes it good for cramped shacks or field work, but I was disappointed with the lack of background colors and the limited color selection. Also you have to fully program all aspects of a memory page before playback is possible. Another drawback is that the Ambico drops off-line if the overlaid video is interrupted. This could be a problem if the input is switched between non-genlocked sources. But at this price it can easily fit into most ATVers' budgets.

Although all the units reviewed provided good quality text on a stable video source, all got the wiggles if the source was much less than perfect. And none had the ability to loop on an action, such as scrolling an information message over and over. The Headerline feature of the Sima ColorWriter was nice, but the Ambico is the only unit that offers flashing text. I believe the Sima ColorWriter is the most versatile titler. With the Headerline feature it offers a stationary text line while other text is scrolled or crawled across the screen.

Still, any of these titlers beats a piece of cardboard on the wall for passing information. All have been in operation for at least six months and are still working flawlessly. Are you old enough to remember the old RTTY pictures made with text? With these titlers you can save the pictures in memories and recall them whenever you want. It's time to break away from those old graphics and put a polish on ATV shacks around the world! 73

73 Review

Dr. NiCad Battery Conditioner/Rapid Charger

Ramsey Electronics Model No. DN-1

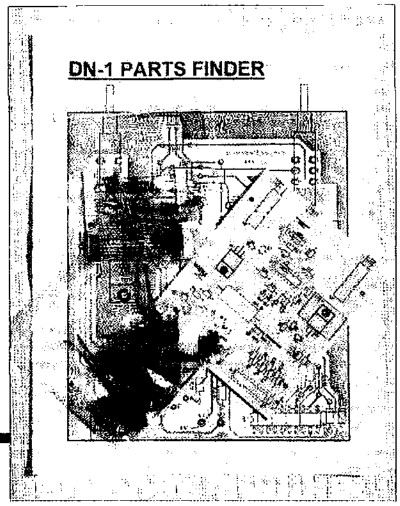


Photo A. *The Ramsey Dr. NiCad kit (all photos by author).*

Mark L. Meyer WUØL
14153 West First Drive
Golden CO 80401

How many NiCd battery packs do you have sitting around the shack? If you're a typical ham, the answer is probably at least two for the handheld and several more for various pieces of equipment—and maybe a few for assorted tools, toys, etc. I started looking around and counted half a dozen at this QTH. Some of the packs were functional, and some were dead; but even the dead ones are too expensive to throw out.

So what do you do to charge all those batteries? Are you charging them correctly? NiCds should occasionally be *nearly* fully discharged and then fully recharged to keep them in good condition. Are you doing that? Is your wall recharger overcooking your batteries when they are connected for weeks on end? What about those dead batteries—can you restore them?

Enter Dr. NiCad

The good doctor can handle all these chores for you, plus provide fast charging for your batteries—without overcooking them. The doctor is available from Ramsey Electronics in kit form or fully assembled. If you order the kit, you can get the basic circuit board and parts only. An optional case set can be ordered to go with the internals.

The heart of Dr. NiCad is the Benchmarq BQ2003 chip specifically designed for NiCd charging. It is programmed by external jumpers on the board and switches to sense how many cells are to be charged, what charge rate is to be used, what discharge rate is to be used, and how long the pack should be charged. The chip senses the correct points to discharge the cells to, at what point to start/stop the quick charge, automatically provides a "topping off" charge and then "tops off" the batteries periodically. It also flashes an LED in various sequences to tell you what is happening.

I got interested in Dr. NiCad when I built a new QRP transceiver. For battery power, I connected two 7.2V NiCd packs together to make a 14.4V pack. The 7.2V packs are commonly used in video camcorders. My packs were rated 1,000mAh (milliamp hours). A 7.2V pack contains six individual cells in series, so I had 12 cells connected in series. The rated pack voltage divided by 1.2 gives you the number of cells in the pack.

Most packs used in handhelds contain from six to 10 cells (some contain 11). NiCds for toys and tools may contain from only one cell to several. As explained above, I wanted to charge 12 cells. As supplied, Dr. NiCad can handle from one to 10 cells but it is easily modified to handle more cells. The number of cells to be charged must be set in the unit by toggling the individual switches on a "DIP" switch unit on the circuit board. Since I wanted to charge more than 10 cells, and I wanted to be able to change the number of cells to be charged from a front panel switch, I modified the unit as described below.

Kit parts and assembly

I ordered the basic kit, consisting of the PC board and the parts to stuff it with. The kit comes in a large plastic bag containing the instruction book, a couple smaller bags with the parts, large schematic diagram of the unit, and a large parts placement diagram.

The instruction book is well done. In addition to showing you how to put the parts together, it gives a fairly detailed explanation of the process of charging NiCd batteries, a troubleshooting section, and a question-and-answer section about operation of the unit. The actual assembly portion has a check-off table for each part; this, combined with the parts layout drawing, makes it very difficult to err in putting the kit together.

The circuit board is high quality and silk-screened with the parts layout. The parts were all present and were high quality although some appeared to be surplus as the leads were clipped. Everything fit and assembly went smoothly.

The heat sink for the transistor that is used to discharge the NiCd packs appeared to be undersized to me, especially since I wanted to use a 12-cell

pack. I beefed this up by bolting on additional aluminum strips. Also, no heat sink compound was supplied to apply between the transistor tab and the heat sink (I added a dab I had on hand). No lockwashers are provided (I used my own).

Modifications

As mentioned above, I wished to charge a 12-cell pack. The unit as provided is designed to charge up to 10-cell packs. How many cells are to be charged is determined by a series string of 47k resistors. This is a voltage divider string. The switches on the circuit board (S1:1–9) merely short out the correct number of resistors as desired. If only one cell is to be charged, all the resistors in the string are shorted out except one (hence the nine switch positions on S1). This one resistor is permanently left in the circuit as designed and cannot be shorted by the switches, as explained in the instruction book.

To modify the unit for 12 cells, two additional 47k resistors must be provided, plus two additional switch positions. I elected to use a front panel switch instead of the circuit board-mounted DIP switch that contained the nine individual switches for shorting the resistors. I used a 12-position rotary switch available from Radio Shack™. I also mounted all the switched resistors (now 11 47k resistors instead of nine) right on the switch tabs instead of on the board. This way only two wires go from the new switch to the board—one from the arm of the switch, and one from the top of the resistor string to the board (**Fig. 1**).

The DIP switch also contained one individual switch (S1:10) to set the discharge rate. When this switch is closed, a low discharge rate is selected. When it is open, a high discharge rate is selected. I decided a low rate was appropriate for all my uses, so I simply jumpered (shorted) the S1:10 holes on the board. Using an additional front panel switch for this function would make it selectable but I didn't choose that option.

I provided my own case. My case setup didn't allow for the use of the "on-off" power switch (S3:A) provided on the circuit board or the "discharge initiate" switch (S2), also provided on the circuit board. I didn't use the switch provided; I simply brought wires from the appropriate holes on the circuit board to the switches I provided on the front panel of my case. The "on-off" switch is just a normal toggle switch but the "discharge initiate" switch is a momentary push-button switch.

Setup

As mentioned above, the discharge rate can be set at a low rate of 140mA or a high rate of 280mA. I decided the low rate of 140mA would be fine for nearly all use. The low rate reduces the heat dissipation of the current pass transistor and the only disadvantage is that it will take longer to discharge than the higher rate. Set the low rate by closing switch S1:10, or by shorting the switch position with a jumper wire as described above.

The charging current rate can be set at 250mA, 500mA, or 1A by positioning several jumpers on the circuit board. The instruction book explains how to calculate the best setting for your pack and then how to set the jumpers. I decided the 500mA setting would be fine for my packs. This too could be set up by switches to make it selectable but would be a little complicated. I used jumper wires as described in the book.

The charging time-out feature is also set up by jumpers. The instruction book tells you how to select the correct time (180, 90, 45, or 23 minutes) for your pack and set the jumpers. I selected 180 minutes for my application.

Power supply

The unit, in kit form or fully assembled, does not provide a power supply for charging your NiCds. It is the controller; you must provide a regulated source of power for the unit. The instructions recommend a "regulated"

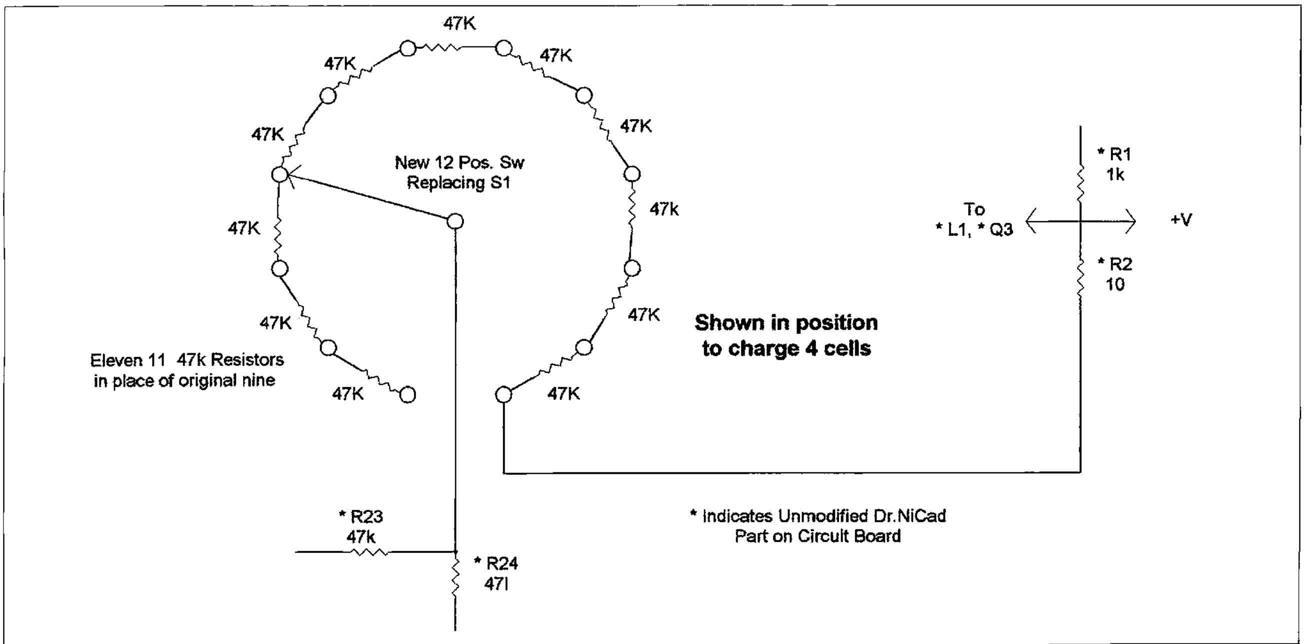


Fig. 1. Modifications to accommodate 12 cells.

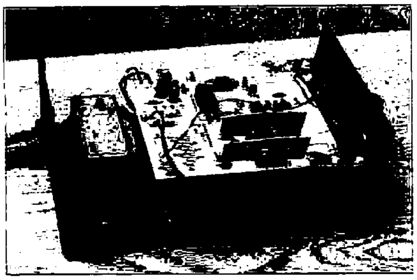


Photo B. The interior, with modifications. Note the extra aluminum strips bolted to the heat sink of the discharge transistor (Q3). The power supply board is mounted below the Dr. NiCad board with the transformer to rear.

supply between 12 and 14VDC capable of at least 1.5A. Most hams have such a supply in the shack already.

I wanted to have the power supply and controller all in one case. I also wanted to charge up to 12 cells, so I decided I would need to provide a slightly higher voltage. The instruction book indicates some problems can be encountered when too high a voltage is utilized with a low-voltage battery pack. With this in mind. I decided to build a supply that could provide a high or low voltage depending on what I intended to charge.

The circuit in **Fig. 2** shows the power supply circuit. It will provide approximately 11V in the "low" position and 18V in the "high" position. The regulator chip, U1, should be a LM317T. The "T" indicates the capability of 1.5A. This is in the full-sized TO-220 case rather than the "MP" series with the smaller tab (rated 0.5A). Use a heat sink with heat sink compound on U1.

The transformer should be rated approximately 18V at 1.5A. I used a 24V transformer (from my junk box) with some secondary turns removed to bring it down to about 20V. Radio Shack™ 273-1515, rated at 18V and 2.0A would be ideal. If you won't be charging a pack of more than ten cells, the Radio Shack 12V, 2A transformer (RS 273-1511) will do the job for T1. In this case you will not need the switch or R3. R2 should be replaced with a 2.0k unit, which should result in a power supply delivering approximately 12V. If the 2.0k resistor is increased slightly in value, the voltage will increase correspondingly.

My unit worked great when I fired it up. I charged up (and discharged) several packs, then tried a pack that was "dead." By cycling the pack several times over a few days, as described in the instruction book, the pack was revived!

I tried another "dead" pack. No matter how many times I tried cycling, this pack remained dead. Three cells out of seven seemed to be shorted. Then I tried an old trick of applying a heavy dose of current to the three shorted cells. I *very* momentarily applied a full 12V from a lead-acid battery to each individual cell. This seemed to cure them. Then I cycled them several times with the good doctor. *Presto!*—another pack restored. **Caution:** If you try the heavy-dose-of-current trick, *be very careful!* Cells can rupture. Use long leads—and place the cells and battery around the corner, or behind something, so you're out of the line of fire should one blow up.

I am very impressed with Dr. NiCad. This is something that should be in every shack. My unit has paid for itself already by restoring two dead packs—and I expect many more years of service from the good "Doctor."

The Dr. NiCad kit (DN-1 @ $49.95 for the kit only) is available from Ramsey Electronics, Inc., 793 Canning Parkway, Victor NY 14564.

The modification parts I used are:

SW1 – Single Pole, 12 position. Radio Shack #275-1385

T1 – Radio Shack #273-1515

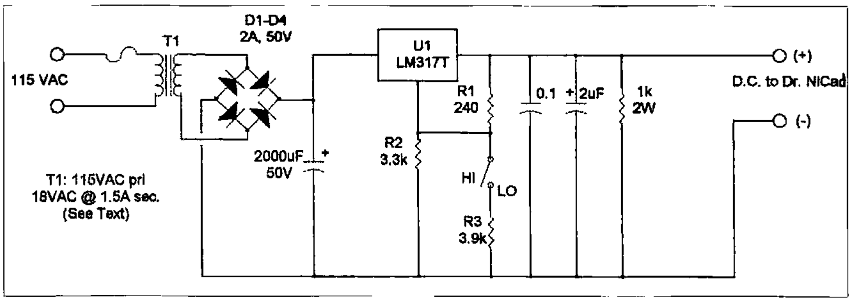


Fig. 2. Dr. NiCad power supply.

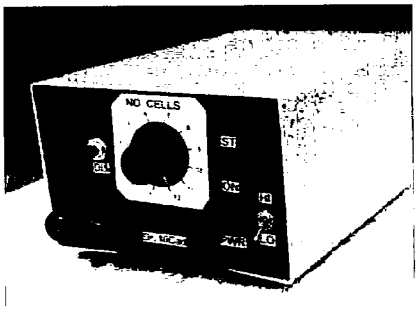


Photo C. The finished project.

D4 – One 2A, 50V bridge unit or four RS-276-1661 (3A)

U1 – LM317T (Digi-Key)

NEVER SAY DIE

Continued from page 5

need is to elect some new younger hams to the ARRL Board to kick that stodgy old organization in the rear to get it moving. And that's entirely up to your club, which is probably also run by a bunch of old-timers, mired in 1930s thinking.

Your choice for amateur radio: grow or go.

Xtal Sets

Have you seen any snot-nosed kids around who might be helped on their downward path in life by an injection of the hamitis virus? This is one virus that not even the bioelectrifier can cure, and it's simple to administer, even in full sight of the parents.

How about sucking the unsuspecting protonerd in with a very simple crystal radio that can be built in about an hour? The parts? Some Tinkertoy spools to support a loop antenna, wire for the antenna, a pair of headphones from the kid's Walkman™, a diode and a tuning capacitor made out of aluminum foil?

Well, that's about what led me into a lifetime of hamming. An angel, or a devil, depending on your viewpoint of me, brought a box of old radio parts into the Dutch Reformed Church I was attending when I was 14. He gave them to my best friend, Alfie, who had zero interest in such junk and dumped 'em on me. I found a circuit in *Popular Mechanics* that used some of the parts to make a cigar box radio. Unfortunately, it worked and I was hooked. For life.

You'll find 15 easy-to-build crystal radio projects in the new *Crystal Set Projects* book from The Xtal Set Society, Box 3026, St. Louis MO 63130. Some great stuff here for science fairs, or even for science classes. The 160-page book is $17.50, including s/h. Be an angel or devil and get busy poisoning some dirty little minds with this book.

Oh Oh Ozoned

A reader sent me more data on the ozone

Continued on page 30

Antennas for Amateur Television, Part 1

An overview of the most useful.

Nizar A. Mullani KØNM
719 Santa Maria
Sugar Land TX 77478
E-mail: [KØNM@amsat.org]

Antennas play a major role in the transmission and reception of P5 pictures in amateur TV. Unlike commercial broadcasters, which transmit with millions of watts of effective power from thousands of feet up, amateur TV is usually limited to a few hundred watts of effective radiated power from a couple of hundred feet of height. Therefore, the signal levels in ATV are much lower than for commercial TV, and high-gain antennas are necessary to provide high gain in both the transmission and the reception of the signal. And, in the fringe areas of reception, a high-gain antenna can improve the signal strength sufficiently to overcome the noise so that a picture is visible.

Several designs of antennas are used for ATV, which operates from 420MHz and higher. As the frequency of operation is increased, antenna sizes become small enough to consider designs that would be prohibitively big for VHF operation. Some of these designs, which we'll touch on in this article, have features that make them very attractive for ATV, such as ease of construction and use.

This first article in a two-part series will cover a few of the more common designs, while next time we'll discuss the esoteric antennas.

The yagi

Most amateur radio operators are familiar with the yagi antenna, which is one of the most efficient antennas for producing high gain with the smallest amount of space and material. Its operation is based on the principle of mutually coupled radiators that are resonant at the frequency of use, and which combine with the fed radiator to produce a unidirectional radiation of energy from the antenna. In other words, a dipole radiator, when placed adjacent to another dipole, will couple energy into the adjacent dipole and the two dipoles will then radiate a pattern as if they were two phased dipoles. The two radiators are then said to be mutually coupled because they can interact mutually with each other. By changing the length of the adjacent dipole and its spacing, the phase of the coupled energy is changed and the radiation pattern can be made unidirectional.

As an example, if an element is made 5% longer than the resonant frequency and spaced 0.2 wavelengths away, it will act as a reflector while an element made 5% shorter and placed 0.1 wavelength away will act as a director. Adding more elements in the antenna concentrates

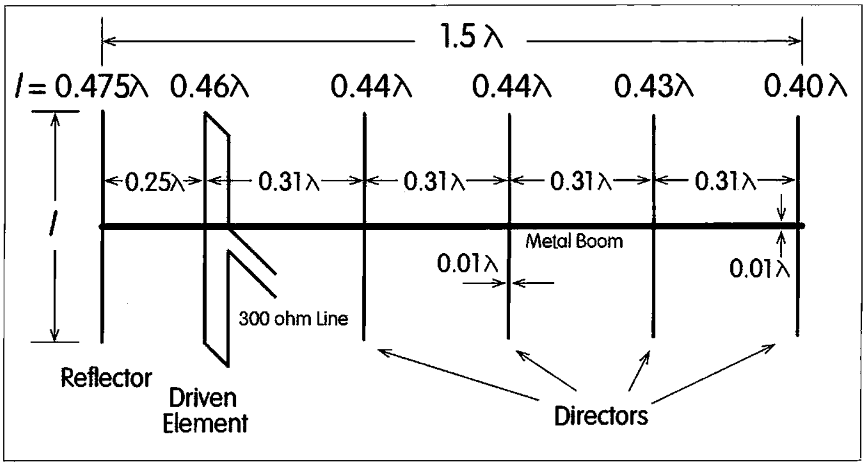


Fig. 1. Typical yagi antenna with one reflector, one radiator, and several directors.

more of the radiated energy into a narrow beam of radiation and increases the gain of the antenna. A typical design for VHF and UHF uses a radiator, one reflector and multiple directors as shown in **Fig. 1**.

The yagi antenna does have its limitations, though. Antenna gains higher than 12dB become harder to produce because of three major factors.

The first is that several directors are required to increase the gain, which in turn increases the length of the boom significantly. As an example, to increase the gain by 2.5dB of a yagi antenna (from 12dB to 14.5dB) requires a doubling of the boom length (from 2.2 to 4.4 wavelengths) and almost doubling the number of directors as shown in **Fig. 2.**

The second is that longer boom lengths require more critical construction so as to reduce the losses caused by errors in spacing of the elements and the critical dimensions of the directors. At high frequencies, such as the 1.2 and 2.4GHz bands, small errors in the size of the directors and reflectors can have major influence on the gain. Therefore, high-gain UHF yagis become very long—and very difficult for the average ham to build.

The third is that yagi antennas have a very narrow band of operation and often have to be tuned to the specific frequency of operation.

Other avenues

There are several alternatives to the yagi antenna for use in the 400MHz and higher bands that have high gains, that are easy to build, and that do not have the limitations of the yagi antenna. In fact, 10 to 13dB of gain can be easily obtained with some designs requiring only simple materials found in the average hardware store. Some of these can be easily built and tested within a few hours—and work quite well for ATV.

The cantenna

The circular waveguide antenna is commonly known as the cantenna among ATV enthusiasts. Its theory of operation is based on the properties of waveguides. In proper-sized waveguides, RF inserted into the waveguide will be propagated within the waveguide with very little loss. At the exit of the waveguide, the wave will exit at an angle that is inversely proportional to the length of the waveguide; the longer the waveguide, the narrower the beamwidth of the radiation pattern. Dimensions of the waveguide antenna are not critical, and feeding the antenna is very simple. **Fig. 3** shows the design of a simple waveguide antenna that can be made out of household materials, such as coffee cans. The diameter of the coffee can needs to be between 0.7 and 0.8 wavelengths in size, and the acceptable range in diameters and inches for the different frequencies for ATV are shown in **Table 1**.

The waveguide is excited with a quarter-wavelength stub inside the can placed a quarter-wavelength from the closed end of the antenna. The length of the antenna should be anywhere from two to five wavelengths, with the longer lengths producing greater gain. Beyond a certain length of the antenna, the gain will flatten out for the classic coffee can cantenna.

Circular Waveguide Dish Feeds	
Frequency (MHz)	Inside Diameter Circular Waveguide Range (inches)
915	8.52 - 9.84
1296	6.02 - 6.94
2304	3.39 - 3.91
3400	2.29 - 2.65
5800	1.34 - 1.55
10,250	0.76 - 0.88

***Table 1.** Dimensions of circular waveguide antennas for different ATV frequencies (from Ref. 1, Table 5, p. 18-14).*

The cantenna is probably one of the easiest antennas to build, and it will yield anywhere from 8 to 10dB of gain with very little effort. The simplicity of the design, the construction, and the feeding of the radiator makes it a must antenna for all ATV enthusiasts. Familiarity with this design is important because it is often used with higher-gain antennas, such as the parabolas, for feeding RF into the reflector.

The helical antenna

The helical antenna is a loop of wire that is helically wound with a circumference of approximately one wavelength and a reflector added to provide a unidirectional radiation pattern. This design is called the axial mode helix because it radiates most of its energy in the axial direction of the winding, compared to the normal mode which has a smaller diameter winding, and which radiates at a right angle to the winding. The normal mode helix is used in short antennas such as rubber ducky antennas.

The axial mode helix has high gain and is a broadbanded design—a fascinating design because of its properties in creating circular polarized radiation. A typical helix has a bandwidth of 1.8 to 1 so that an antenna designed for 900MHz will easily work at 1.2GHz.

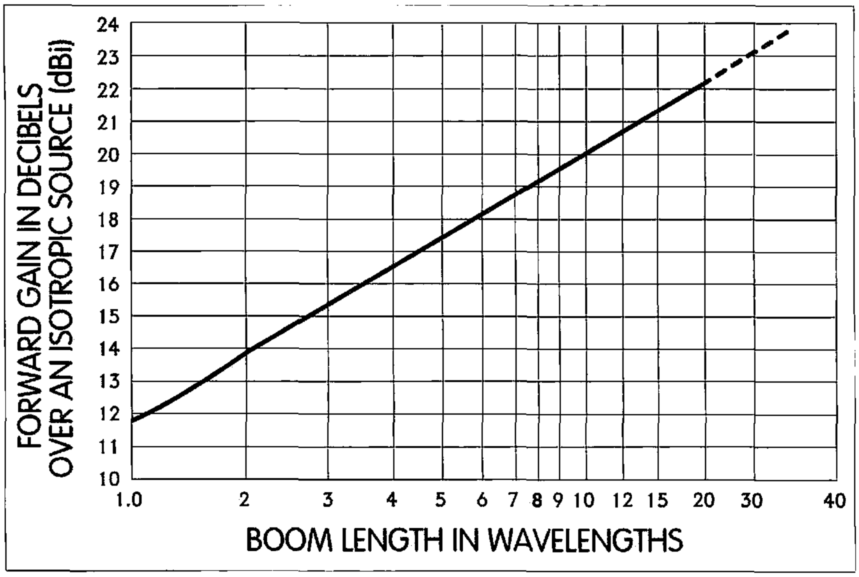


***Fig. 2.** Theoretical gain of the yagi as a function of number of elements and the boom length.*

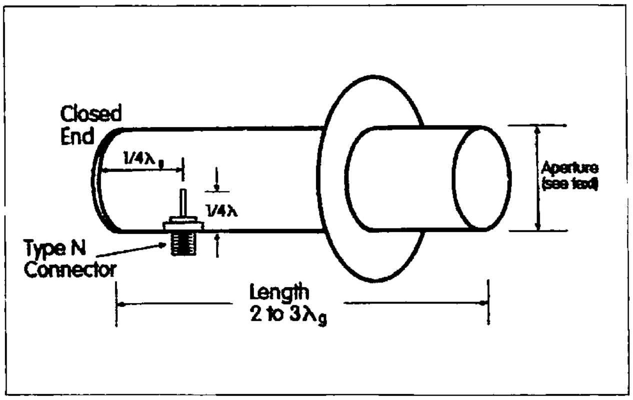


Fig. 3. Circular waveguide antenna (cantenna). The length of the antenna can be increased to 5 wavelengths for higher gain. The disc shown on the antenna is for use when feeding a parabolic reflector.

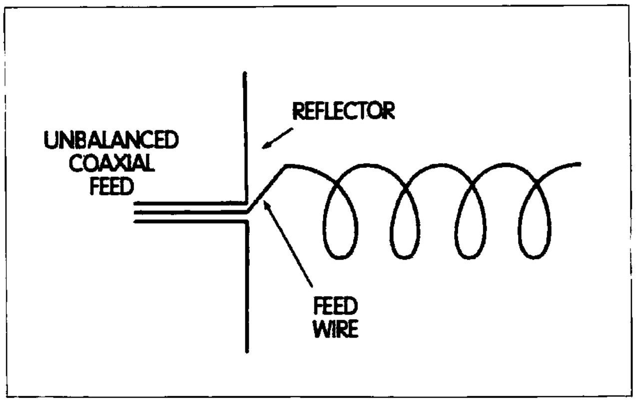


Fig. 4. The helix antenna.

The mechanical layout of the design of a helical antenna is shown in **Fig. 4**. The gain from a typical seven- or eight-turn helical antenna is approximately 12dB, but because of the circular polarization of the antenna, you need to deduct 3dB if you are operating into an ATV antenna, which is either horizontally or vertically polarized. Also, when using the axial mode helix, it is important to choose the correct polarization of the antenna between the right circular and the left circular. A mismatch between the transmitter and receiver polarization will result in almost no gain for the antenna.

The advantages of the helical antenna are that the construction of the design at UHF frequencies is easy and non-critical. This is not true at the lower VHF frequencies, where it becomes difficult to hold the helical windings in place. Another advantage is that the broadbanded nature of the device makes it easy to construct and use. The circular polarization of the antenna is useful where the polarization can fluctuate—as in satellite, balloon, or mobile transmission. The major disadvantage is the higher-than-normal feedpoint impedance, which requires a little bit of matching for 50Ω operation. A winding of one wavelength in circumference, which is what is normally recommended for this antenna, will have a feedpoint impedance of approximately 140Ω and will change as a function of the frequency. Therefore, the operation of this antenna into 50Ω will require some form of matching to the 140Ω, such as a quarter wave of 90Ω transmission line.

The yagi, cantenna, and helical are three antenna styles that are high in gain, easy to build, and a must for the ATV enthusiast. Next time, we'll cover more ways to get the most gain from your ATV antenna system.

References

1. *The ARRL Antenna Book*; ARRL Publications, Newington CT, 1994.

2. *Antennas* by John D. Krauss, 2nd Edition; McGraw-Hill International, New York NY, 1988.

3. *The Amateur Radio Handbook*, 3rd Edition; Radio Society of Great Britain, London, 1961.

4. *Radio Handbook* by William Orr, 18th Edition; Editors and Engineers Ltd., Indiana, 1970.

NEVER SAY DIE
Continued from page 26

layer peril and the terrible contribution to it by man's CFCs from Freon™, hair spray, and so on. It turns out that most of the chlorine getting into the air comes from ocean spray, with a minor amount coming from volcanoes. Man's contribution, it turns out, amounts to 0.000015 percent. Which backs up my April editorial comment about DuPont™ paying off environmentalists to ban the use of Freon once their patent was running out, a shrewd political move which has cost us consumers (the suckers) hundreds of billions of dollars. Was that you out there screaming for Congress to ban CFCs? And did you drive to school in a panic to grab that Alar™-sprayed apple from your child?

If you keep re-electing your congressmen nothing is going to change. Give 'em all one term and out. Let's do away with those re-election campaigns and the bribery they foment. We've tried using professional politicians and look at the mess we're in, so let's start electing amateurs. Non-lawyers, if at all possible.

Tandy™ Shakeup

Thanks Rick KA5PVT, for the newspaper clipping about a major Tandy shareholder asking the board of directors to replace John Roach. Far's I'm concerned the Tandy board has to have been asleep for the last 15 years or they'd have canned Roach long ago. 15 years ago Radio Shack™ had 40% of the personal computer market. Then along came IBM and RS sales plunged to around 4%.

How'd IBM pull a coup like that? By doing exactly what I recommended Roach do with the TRS-80 computers. It was bad enough when I personally tried to convince Roach to open the TRS-80 operating system up. But when he refused to budge, I made the same recommendation in an editorial in *80-Micro*, along with a prediction that if he didn't, the TRS-80 could get blown away.

Since one of the key developers of the IBM PC system was a ham with whom I'd

gone on a DXpedition to Navassa (KC4DX), I had more than an inkling of the IBM plan.

As the editor and publisher of *80-Micro*, which was running around 600 pages a month (the third largest magazine in the country), I had refused to let Radio Shack advertise in my magazine devoted to the TRS-80 because I felt that Roach's marketing policies were too destructive.

The Last *Callbook*

The 1997 North American edition has 2,219 pages, is two and a half inches thick, weighs in at about five pounds, and costs $40. Better get one, since this is the end of the line—the last *Callbook* they're going to publish in book form. From now on it's only going to be on CD-ROM, which, as far as I'm concerned, is a royal pain in the ass. I want a *Callbook* in my office so I can look up ham addresses. I also frequently need it in the hamshack across the road. I can take it to where I need it, whether it's to the typewriter for addressing an envelope, to my computer to put an address into my frequently used address file, or wherever. Even a five-pound book I can move to where I need it. A CD-ROM version is rooted to my computer and takes a lot longer to use.

Similarly, I have a nice dictionary built into my Word program, but most of the time it's faster to grab the *Funk & Wagnall's* off the shelf.

My ROM drive is usually kept loaded with my PhoneDisc so I can look up phone numbers and addresses. That's turned out to be very handy. So, unless you have a computer set up near your rig, you'd better grab a 1997 *Callbook* printed version while they last.

Business Incubation

A report in the April issue of *Dividends*, the Staples™ magazine for small businesses, shows that the success rate for new businesses started in incubators is 80-90%, according to the Ohio-based National Business Incubation Association. Compared to the normal success rate after five years of around 10%, this is a powerful recommendation for business incubators.

Several years ago I was approached by the School of Management at Rensselaer Polytechnic Institute to help them reorganize their curriculum. This resulted in my becoming a member of the RPI Council, the Steering Committee, and their first Executive in Residence. Soon I was consulting for the president, which resulted in the founding of two entrepreneurially-oriented new schools at the university. My consulting for their business incubator project resulted in their making some major changes, with their winning the prize last year as the best incubator in the country.

What I'm proposing is a way for any small town or community to set up a small business incubator and start growing new businesses. As our big businesses downsize and

Continued on page 85

Home-brew Yagis For Amateur Television

Easy to build, easy to use—and not just for beginners!

Ed Manuel N5EM
10430 Sagevale
Houston TX 77089

When the Houston Amateur Television Society (HATS) began to promote amateur television in our metropolitan area, the first order of business was to get people watching the ATV repeater. It's hard to get someone interested without seeing activity. Our repeater uses 421.25MHz (conveniently, cable television channel 57), so just about everyone has an ATV receiver already. All that is needed is an antenna.

Almost everyone who has a television, also has an antenna. Unfortunately, 421.25MHz is far enough from UHF channel 14 (480MHz) that most commercial television antennas we have tried perform poorly unless the station is close to the repeater. Unless you live in a small area, you almost never get to point your antenna at the commercial TV stations and at the ATV repeater at the same time. One amateur in Houston actually lives close enough to the repeater to watch ATV with rabbit ears—but this is the exception.

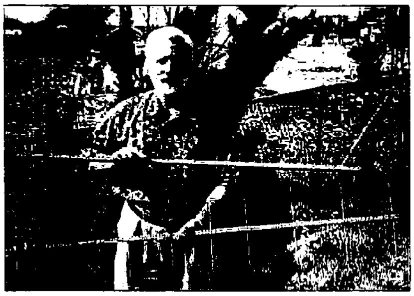


***Photo A.** The author, Ed Manuel N5EM, holds a 70cm ATV yagi and 1.2GHz yagi still under development. Activity in the background is a North Texas Microwave Society antenna measuring party.*

For most of us, an antenna specially tuned for the ATV repeater is a better choice.

A couple years ago I attended the Dallas Hamfest. A friend of mine (Kent Britain WA5VJB) was presenting an article on his latest microwave development—a series of antennas for 2m through 23cm, for use with a rover station during microwave contests. Kent is aware of many other VHF/UHF pursuits besides small signal contesting, and has created designs for amateur satellite work, FM repeater work and amateur television. My attention was immediately captured.

It soon became apparent that we had struck gold with Kent's design. In the two years since making the first antenna, we have distributed more than 100 of these as kits or finished antennas in the Houston area. They have proved to be easily reproducible and reliable. Many of them have been handed to new amateurs who have never built anything. Some hams were so new to amateur radio that they had only been active in two meters with hand-held radios. No one has ever tried to get one of these antennas working and *failed.*

Many hams have been taught that yagis are nearly impossible to build properly. In every case, the problems can be traced to the builder's failure to construct the antenna exactly as described. In order to make our antenna design reproducible, we decided to package them as kits. The kit solves many problems. By providing all the elements and a pre-drilled boom, along with a properly terminated coaxial pigtail, success is assured.

Kent's antenna is a marvel of simplicity. He created a design that keeps the element lengths in even fractional-inch dimensions so one can measure them accurately with a simple ruler.

Materials include wooden booms and brass welding rod elements. The driven element is a J-shaped rod that resembles a J-pole antenna. By using a simple driven element and adjusting the spacing of the reflector and first director, Kent managed to make the feedpoint impedance of the driven element match the desired feedline impedance without an adjustable match. This removes the greatest challenge for the inexperienced builder. A typical 421.25MHz receiving antenna is very difficult to adjust by normal methods. Most hams don't have a 421.25MHz transmitter with a 75Ω output and 75Ω SWR bridge—but all one has to do is adhere to the design and the match is so close no adjustments are needed.

Construction is simple

Start by buying good quality one-by-twos or one-by-threes (I prefer poplar

***Photo B.** Close-up of the yagi feedpoint. The shield goes to the half-wave portion of the driven element, while the center conductor goes to the quarter-wave portion. Note the thicker area of the boom.*

with oak as a second choice), and rip them into square booms, 3/4-inch x 3/4-inch by six feet long. If you don't have a table saw, just ask around on the local VHF-FM repeater. A short section of the boom is cut off and glued to the back of the boom (**Fig. 1**). This double-wide section does two things: It provides a larger area for mounting a U-bolt and it provides some additional boom width for the driven element. The J section is a bit wide for the 3/4-inch boom. After measuring the hole spacing along the boom and drilling the holes (1/8-inch for the welding rod), the boom is ready and can be put aside.

It takes about 15 minutes to cut out the brass rod elements. (See **Table 1** for dimensions and spacing information.) There is some waste since brass welding rod typically comes in 36-inch lengths. The best method is to cut the longest rods first (reflector end of the antenna). After each cut, measure the leftover piece and compare it with the shorter lengths required. If you need to make other antennas for higher bands (smaller elements), then you don't have *waste*, you have extra material.

Clean up the ends of the elements with a file and insert them into the boom according to length. They go longest to shortest from rear to front. Center them with a ruler. When you like the placement of all elements, put the antenna into a vise and put a drop of glue or cement on each element where it enters the boom. I like to use a thick cyano-acrylic glue (SuperGlue™) that is sold in model shops. It is available in a quick-drying formula that makes it easy to work with. You could also use epoxy cement. When the glue or epoxy is set, turn the beam over and do the other side. Leave the antenna overnight until the glue is completely dry.

Now attach the feedline. This is a 75Ω antenna, designed to feed the 75Ω input of your television. The pigtail is a short length of RG-59, RG-6 or other 75Ω cable. Solder this cable to the feedpoint. Look for cable with a copper or tinned (solderable) braid. It's not possible to attach the aluminum foil-shielded types of cable to the driven element. One type of cable I prefer is a 75Ω Teflon™ type used in air plenums in office buildings. This cable has a Teflon outer jacket and inner dielectric. The braid is made from copper wire and the center conductor is copper plated steel. The Teflon is impossible to melt, which is a boon in soldering to the 1/8-inch brass welding rod. One local antenna builder buys regular RG-59 cable at Radio Shack®. Careful soldering avoids the need for Teflon, but it's not easy. Pre-tinning the brass rod at the points of attachment makes this process easier.

Terminate the pigtails in a standard "F" connector (crimp type). This makes it ready to connect to an "F" type barrel for connection to your feedline or allows easy insertion of a TV type preamp if needed. If you want to build your preamp, the ATVers in Atlanta published a neat design (see Bill Brown WB8ELK's "ATV" column, *73*, September 1994).

The builder must give careful thought to weatherproofing these antennas. The

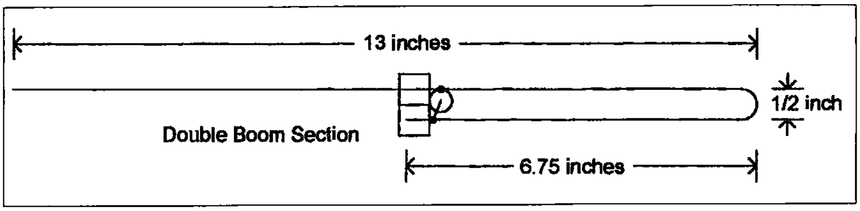


Fig. 1. Specs for a driven element.

boom is wood and will absorb water, ultimately warping. Some builders use two or three coats of quality outdoor varnish, followed by two coats of an outdoor lead-free enamel (stealth gray, of course). The feedpoint should be given several coats of clear paint (RustOleum™) to keep the solder from weathering. The connectors are not weatherproof and must be protected as any other connector. Use some good product like Coax-Seal™ or RTV™ (non-corrosive electronic type).

As with other UHF antennas, the higher this antenna is mounted, the better—with one caution: There is no need to get the antenna higher than absolutely necessary. If you get perfect reception at 35 feet but have a 90-foot tower, resist the urge to go to the top. That additional feedline to get to the top has loss. It is quite possible to lose signal by having more feedline loss than you would have if you mounted it just high enough to clear local clutter and vegetation. Since this antenna is designed to be rear-mounted, it is perfect for mounting on a tower leg and pointing (permanently) at the ATV repeater. Remember that this antenna is designed for 421.25MHz. That's a repeater output frequency and is rarely used for point-to-point operation. If you want to chase DX to distant repeaters you might want to mount the antenna on a rotatable mast. If you find you need a very long feedline, you should consider using RG-11 instead of the smaller, more lossy cables. You might also find you can get 75Ω hard line used to build cable television systems from your local cable TV company for free. Any length less than several hundred feet is scrap to a cable company. Connectors are a bit difficult to obtain, but are not that difficult to make.

If this antenna is not big enough for your location, there are other options. You could get a commercial antenna, like the M2 440-21 ATV. This antenna is over 14 feet long and is one of the largest commercial ATV antennas available. An alternative to purchasing a commercial antenna is to phase an array of two or four of these home-brew yagis. Two will provide almost 3dB of additional gain. Four will provide almost 6dB more gain. The stacking distance is a modest 28 inches and an array of four is not impractical.

Phasing multiple antennas

For 70cm, remember that we are dealing with 75Ω antennas. In Houston we have chosen to parallel two antennas with an F-type tee. The resultant impedance is now 37.5Ω. At this point, a quarter-wave transformer of 50Ω cable brings the impedance up to 75Ω again. If you want to phase four together, you simply do this twice. The recommended stacking distance is 28 inches, which makes a nice, compact array. If you make your 75Ω pigtail from the antenna 20 inches long (approximately 19 inches after you strip and attach it to the driven element), you will have a perfect length to reach the tee. You can find RG-58 cable with a solid center conductor which can be terminated in F connectors. We currently have a couple of dual antenna arrays in Houston (and plans to build a quad array).

One last note about stacking is: When viewed from either the front or rear, your driven elements should appear identical. The J driven element we are using has a long side, a short side and a folded end. Each part of the element should be positioned exactly as every other element. If you inadvertently flip one, you will have it out of phase with the rest of the array. Double-check to make sure that you are feeding the end of the short side and have attached the shield of the coax to the center of the long side. These little things can really mess up the pattern and performance, and are hard to fix after putting the array in its final mounting position.

Your antennas should match the polarization of your ATV repeater. In Houston, we use horizontal polarization on 70cm and vertical on all other bands. Of course, that is always subject to local decision and changing RF environments.

There are certainly other antennas that can be used for ATV. The yagi described here is just one approach. We have found it to be easy to build and very effective—great for the new ATVer.

Additional documentation on the antennas is readily available to those who wish to make one for other bands. You can make a call from a FAX machine to our fax-back server in Houston. Just call (713) HOT-FMTV and follow the instructions to get the antenna documents, which include designs for every band from two meters to 23cm.

I strongly encourage ATV clubs to consider making kits like this available to hams in their communities. If you want to promote ATV, it's easier to hand someone a kit and show him how to make it work, than it is to *tell* him how and expect him to do it. We have sold these kits in the Houston area for $15. You could build them for about $10 but you would have to gather all the pieces. Many people would like to have ATV receive capability but will never get around to it. Put a kit in their hands. Get them receiving the local activity and they will get interested in a hurry—at least, they will if your ATV activity is interesting—but that's another article.

70cm Yagi for 421.25 MHz (75Ω Feedpoint Impedance)

Element	Length	Location
Reflector	14.00	0.00
Driven Element	13.00	3.00
Director 1	12.50	6.50
Director 2	12.25	12.25
Director 3	12.25	17.75
Director 4	12.00	24.50
Director 5	12.00	30.50
Director 6	12.00	36.00
Director 7	11.75	43.00
Director 8	11.75	50.25
Director 9	11.50	57.25

Note: If rear mounting is desired, space must be left behind the reflector.
All dimensions are in inches.

Table 1. Dimensions and spacing for the elements.

Rocket Video

Video beyond the speed of sound.

Jeff Johnson KC5AWJ
17423 Landon Oaks Drive
Houston TX 77095
[kc5awj@stevens.com]

Have you ever been inside a sonic boom? Most people haven't, except for the few people flying military jets or the Concorde. With ATV, you can do it, without leaving your lawn chair.

Pushing the edge

We have a group within the Houston Amateur Television Society, Inc. (HATS), that is constantly looking for new and interesting ways to use ATV. We are the "toy" group: those who are looking for strange and exotic video viewpoints. I've been flying model rockets since the late '60s but had grown away from it during college. About four years ago a long-time friend invited me to one of the South Texas Balloon Launch Team meetings and introduced me to HATS. Several members were getting into the next level of rocketry—amateur rockets. They had outgrown the smaller Estes rockets and were reaching for the stars—or parts of the upper atmosphere. I went to a couple of the rocket launches, scheduled events requiring FAA flight clearances, and met someone I recognized. It was my family physician, a licensed manufacturer of Aerotech™ reloadable rocket engines under the "Dr. Rocket, Inc." name. He was fascinated by amateur television, and was interested in using it in rockets to record the flight and aid in recovery.

Early attempts at ATV were cumbersome, and not too impressive. A guy flying his 8mm camcorder had much better video... until the flight when the parachute didn't open and the camera recorded six inches into the ground. With newer equipment and smaller cameras now available, a more robust ATV system can be flown. It still costs as much as a good camcorder but allows instantaneous viewing, doesn't suffer from the tape being pulled away from the recording heads by G force, and allows the recording of a flight where a tape system would destroy itself *and* the tape.

This system is being designed for a rocket with an outside diameter of 98mm, about 3.9 inches. To balance the engine system, the rocket and electronics must weigh almost 15 pounds. The engine system is a reloadable "N" motor.

If you launched rockets as a kid, you probably used B4-2, C6-5 and D12-7. This alphanumeric naming has some forethought to it. For every increase in letter designation, the power of the engine doubles. Two "Bs" equal one "C", two "Cs" equal one "D"... which makes an "N" motor roughly equivalent to 2Ms = 4Ls = 8Ks = 16Js = 32Is = 64Hs = 128Gs = 256Fs = 512Es = 1024Ds = 2048Cs. This is not something you buy at the local hobby shop! One of the requirements for purchasing motors of this class is membership in a recognized amateur rocketry organization and successful flight demonstrations to flight observers certified in the motor classifications of intended use.

A reloadable motor has a higher initial cost than a single-use engine but also has the advantage of being reusable—similar to the space shuttle's solid fuel boosters without the O-rings. Our rocket is projected to fly to 30,000 feet at a speed of more than Mach 1.6 (about 1,100 miles per hour).

The plan

We wanted to create a system where as much information as possible about the flight was sent to the ground fast enough to provide time to react to problems (the nose didn't separate; the main parachute didn't deploy), so we could send a ground command to correct the errant system. To accomplish this, we have two microcontrollers, with sensors for G-force, velocity, temperature, and absolute pressure, in conjunction with two video cameras providing a view

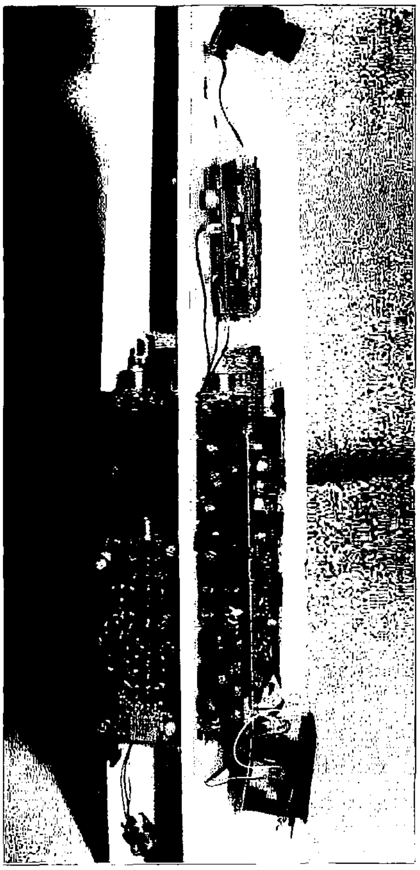


Photo A. Mockup of nose cone with cameras and transmitters approximately positioned.

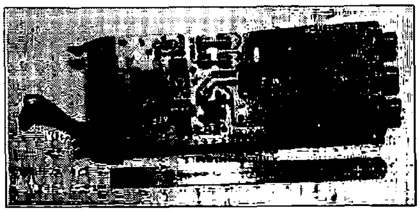


Photo B. *Delta prototype transmitter with one audio channel installed.*

straight out from the rocket (the horizon camera), and another looking down and along the rocket (the "been there" camera). The horizon camera will display sensor information using a two-line video title chip fed by one of the controllers. Both cameras feed separate transmitters (one with audio to hear the BOOM) and then combine at the high power amplifier to be transmitted through one J-pole antenna.

The body tube diameter (inside diameter of 3.625 inches) was a compelling reason to repackage the Houston Amateur Television Society (HATS) TR1 "Charlie" revision transmitter into a form that could be reshaped based on available space. The Delta transmitter can be separated into three separate modules and positioned as needed to fit small spaces. The Delta modules became small enough to allow the entire video system inside the nose cone. It also helps to have a nose cone almost 4 inches in diameter and 20 inches long! Most model rockets aren't this big!

We had to create a small mixer board that would combine the two video signals and adjust the power level before feeding it into the high power amplifier (HPA). Several ideas were proposed, but the easiest solution won out. We had two 50-ohm signals that we wanted to combine into one 50-ohm output and at the same time cut the power level. A small piece of copperclad, three chip resistors picked by using a neat little program created by Teledyne, and we have a pad to adjust the power level into the high power amplifier. Just what the doctor ordered!

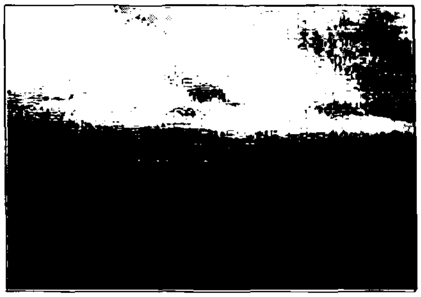


Photo C. *The view from approximately 3,000 feet. On a very good day with three stages, an Estes Farside™ could get to little more than half this height. (Photos from South Texas Balloon Launch Team's flights.)*

The cameras

The horizon camera used is a color teleconferencing camera made by Intel™. It is a standard output NTSC (RS-170A) unit with resolution of 330-350 lines and amazing light sensitivity (near 1 lux). The camera lost 348 grams with the removal of the swivel base and steel RF shield, to weigh in at 72 grams. One really nice feature of this camera is the power switch. In the original case, opening or closing the lens cover would turn the camera on or off. I can wire the camera so it runs any time power is applied or add a relay to one of the controller boards and control the camera with the microprocessor unit.

The "been there" camera is a high-resolution color board camera from Edmund Scientific™. It has NTSC output, 450 lines of resolution, 5 lux sensitivity, and a 3.8mm f/5 lens. It weighs 68 grams. It is rated for only 6.8G non-operational, so additional work will need to be done to keep this camera in one piece and operating at 10-15G.

The video transmitters

Two Delta transmitter prototypes are being used: one is video only at 1247MHz, and the other has one audio channel at 1255MHz. The VCO sections have been separated and stacked underneath the audio/video section.

Antenna

The first pass antenna is a J-pole driven element from the HATS 20-element yagi for 1.2GHz. A null is expected to appear as the rocket gains altitude. We will compensate for this by having the receivers positioned about one mile from the launch site. Depending on how much this null interferes with reception, we may need to use a quarter-wave stub under a ground plane to reflect the signal down toward the ground. The stub-under-ground has worked well for South Texas Balloon flights but does require

Photo D. The halfway point for a normal flight, 18,000 feet.

that the antenna remain in a more or less vertical orientation.

Controller board

The controller has yet to be finalized (at this writing). The microcontroller (MPU) is a Microchip PIC14000 which contains 7 A/D channels with 10-16 bit resolution, an internal temperature sensor, internal watchdog timer, and up to 20 I/O pins for digital controls. Pressure sensors consist of a Motorola MPX5100A absolute pressure sensor and a Motorola MPX5500DP differential pressure sensor. The absolute pressure sensors will be used to calculate approximate altitude while the differential sensors will provide velocity data. A Motorola MMAS40G10D accelerometer chip (0-40G) will provide acceleration rate information. The MPU will use its internal time of flight counter, altitude data, velocity and acceleration to determine where it is in the projected flight path. This information will determine when the rocket will separate at apogee (maximum height) and when the main chute will deploy at approximately 2,000 feet above the launch site. This information will also be displayed on the horizon video channel using an NEC uPD6450 video titler chip.

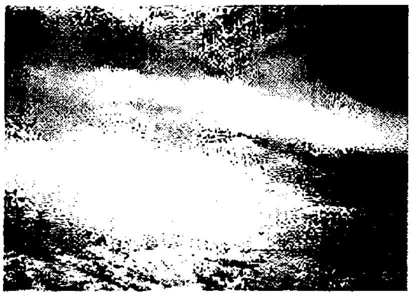


Photo E. The Gulf of Mexico is visible from 30,000 feet, the projected range of the author's project rocket.

Nose cone

The nose cone itself is 19.375 inches long, 3.875 inches in diameter. An additional 12 inches of length will be added to the nose cone for ballast and batteries. It is being constructed using E-Glass™, an aerospace application Fiberglas™ reinforcement, and five-ounce Kevlar® in the structural reinforcement areas. Lexan® "windows" will be molded into the glass reinforcement.

Photo F. Only rockets on steroids get up to 93,000 feet. Barely visible midway across the photo is probably Venus or Mars.

Number 38 on your Feedback card

73 Review

Full Rock and Roll

The AT-11 Automatic Antenna Tuner from LDG Electronics.

Marshall G. Emm AA0XI/VK5FN
2460 S. Moline Way
Aurora CO 80014
E-mail: [aa0xi@mtechnologies.com]

For several reasons, I have always been skeptical of automatic tuners. First, for the most part they are very limited in the degree of mismatch that they will handle. Second, they mostly "go with" an expensive transceiver they have been specifically designed for. Third, and most important, they have been extremely expensive, especially for something that is usually a ham's first home-brew project—made out of old radio parts and junk.

The AT-11 is relatively inexpensive, it works well, and it will work with any transceiver—just hook it up in your shack in place of your existing manual tuner, connect 12V, and you can almost forget it's there. The AT-11 was originally published about 18 months ago as a *QST* project, and is now available in two separate versions—a QRP version, and the QRO version (which I built for this review). Either version can be purchased with or without a nicely laid out enclosure. The QRP version is small enough to fit *inside* some QRP transceivers; the optional enclosure for the QRO version is only 6.5 x 8.5 x 2.5 inches. That makes it very attractive for mobile use.

How it works

The AT-11 uses 17 relays to switch between combinations of eight fixed inductances and eight fixed capacitances in either a low- or high-impedance configuration (the capacitance is switched to either precede or follow the inductance in a traditional L configuration). Thus there are 256 inductance combinations possible, and 256 capacitance combinations possible in either high- or low-impedance configuration, for a grand total of over a quarter million tuning combinations. The AT-11 uses its microprocessor to set combinations of inductance and capacitance, and check the SWR with each one, until a suitable match is found. Depending on how many combinations are tried, the unit will require from one-tenth of a second to 6.2 seconds to either find the match or indicate that one can't be found. The current SWR reading is indicated by three LEDs: green, 1.5:1 or better; yellow, 2:1 or better; and red, greater than 3:1. The intermediate ranges of 1.5-2 and 2.5-3 are indicated by lighting two adjacent LEDs. So, for example, if both the yellow and red LEDs are lit, you will know that the SWR is between 2.5:1 and 3:1. A fourth LED indicates that tuning is in progress. After tuning, the AT-11 "goes to sleep" so that stray hash from the processor doesn't interfere with reception.

The AT-11 has two modes of operation—automatic or semi-automatic. In fully automatic mode, the tuner "wakes up" when you transmit, monitors the SWR, and immediately attempts a rematch if the SWR increases to more than 3:1. In semi-automatic mode, you can push a button to make the AT-11 go into the tuning algorithm at any time. In either automatic or semi-automatic mode, you can use four buttons on the front panel to increase or decrease either inductance or capacitance by one step at a time. This last feature is particularly useful because in seeking a match the AT-11 will stop if it finds one with a resulting SWR of 1.5:1 or better. Thus, the tuner may stop with a 1.5:1 match in situations where a closer match can be attained; you may be able to get it closer to 1.0:1 by nudging the buttons. I know, the textbooks say that for all practical purposes you might as well leave it at 1.5 to 1. With QRP gear, however, the heat generated by an SWR of 1.5:1 in the final transistor can be harmful—and it is often *fatal* (to your final, that is) to operate these rigs with an SWR of 2 to 1!

Another aspect of the tuner that I should mention is power handling. The QRO version of the tuner is spec'd at 100W but will in fact handle about 150W on a 50% duty cycle (e.g., CW and SSB). When tuning, of course, there can be combinations which result in high voltages on the relay contacts and stray RF around the circuit board, so

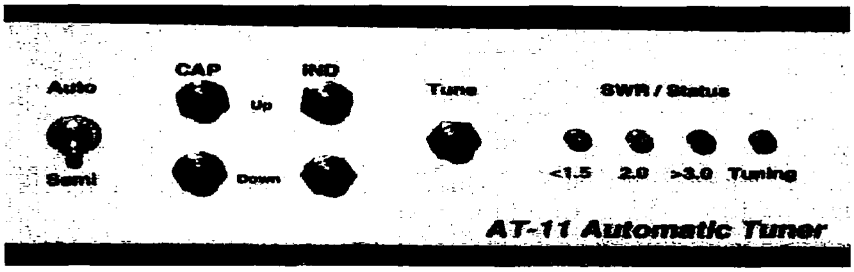


Photo A. The AT-11 Automatic Tuner is ready to go.

LDG recommends tuning with 10W or less—the AT-11 will respond with as little as 2W of applied RF.

Construction

In some respects the AT-11 is very easy to build but it can be frustrating because of discrepancies between the silkscreen overlay on the board, the overlay diagram, the parts list, and the schematic. Most such problems should be rectified by the time this review sees print, so keep in mind that the comments were based on the version current when I built it.

An experienced builder will require five or six hours to complete the kit—there are over 200 components and 500 solder joints, so do take your time!

The kit will require a high level of soldering skill—many of the tracks are quite close and the components are small. For example, the 1/8W resistors are about half the size of those most of us are used to working with, and the processor chip socket has 52 connections. An added complexity is the addition of five components on the foil side of the processor socket—these are extremely close solder pads and in one case you need to tack the leads from three components to a single pad.

There is a reasonably complex bifilar transformer, and eight toroidal inductors to wind. The instructions are clear, and only the transformer is really challenging. The eight toroids are quite large, as is the wire, so you should have no difficulty if you follow the instructions. An easy mistake, though, is to wind in the wrong direction, in which case the resulting coils will not fit properly on the board and you will have to do them over. The transformer is a little more difficult, but certainly not beyond average skills. Note that it is mounted flat to the board, though, or you will have difficulty running the antenna input wire through the middle of it!

Apart from the winding of toroids, the instructions are somewhat rudimentary, and you will be well advised to read through the entire manual before touching the board with a soldering iron.

First, as is my normal practice, I soldered in the IC socket, and I suggest that any builder should start with that. The first soldering instruction in the manual is: "Parts are installed and soldered in order of height, from shortest to tallest. With the PC board blank, it is easiest to install all of the resistors first." The problem with that is that a number of the resistors share a solder pad with another component (e.g., 18 or more transistors) and if you aren't extremely careful you will occasionally fill the other hole with solder. It's fairly easy to identify those situations as you go and postpone the resistor until you do the other component, but the point is that you don't always *have* to follow the instructions step-by-step, and in this case it might be a good idea to exercise a little discretion. Ticking the components off on the overlay diagram as you install them is a good way to keep track.

There was a problem mounting the ribbon cable connector on the board—it may be rectified by the time you read this, but the pins are too big for the holes. The solder pads are not large enough to drill the holes out, so LDG's recommended solution is to tack-solder the connector to the board and then flow solder through the holes from the other side. The result is quite strong enough, and electrically sound if you have in fact determined that solder has flowed through onto the pins. The one large diode is also too big for its britches, but I found that those holes *could* be drilled out enough to make it fit. If you don't have a small enough drill, you can of course solder the diode to the top of the board.

Two of the .01 caps turned out to be "ring-ins." I had *three* left over when I thought I was finished, so I did a comparison between the schematic, the parts list, and the parts overlay. The parts list accounted for 53; add two (which don't have C numbers) for the processor mod and that makes 55, or one left over. I checked them off one by one and discovered that not only had I not installed C67 and C70, I couldn't figure out where they were supposed to go. According to the schematic they should be located near the power switch, but everything in that part of the board was accounted for. Eventually I had to contact LDG for clarification, and was informed that (a) there was an extra cap supplied, and (b) C67 and 70 had been deleted from the power input and "relocated" near relays 8 and 17. Sure enough, they do appear on the parts overlay diagram and there are holes on the board for them. I'd missed them because with that one exception the parts lineup for each relay is identical. By the way, LDG's support, in the person of Dwayne Kincaid WD8OYG himself, was fast and courteous. Help *will* be available if and when you need it.

The smoke test

Once the board is complete, you are instructed to connect power and check a couple of voltages and current before inserting the CPU chip. The only trap here is that if you have been following the instructions exactly, you will have mounted the power jack on the circuit board, but you haven't yet connected the switch—to apply voltage to the circuit you need to either hook up the power switch or apply the supply voltage to the hot side of the switch pads on the board.

The next step is to install the board in the (optional) enclosure, wire up offboard connections, and insert the CPU chip (using standard anti-static precautions, of course). The panel wiring is straightforward, as long as you are very careful with the ribbon cable. I made a mistake and cut one lead to the wrong length, so I had to repair it. When I'd finished the wiring, it seemed sensible to create another testing stage and repeat the power-on checks before inserting the CPU chip, and the clacking of a relay told me that I had indeed been wise. One of the tacked-on components on the bottom of the board had been pressed against another pin on the CPU socket.

Calibration has a catch to it, too. It should be very easy, since all you are doing is setting the pickup voltage level for the SWR circuit and balancing the forward and reverse detection circuits, but the instructions have R53 and R54 reversed. Fortunately, common sense says that when you are measuring the forward voltage you adjust the trimpot labeled "fwd," not "rev." And *experience* says that if you use the R numbers in the manual you will not align your tuner, period. Once the unit is aligned and you are ready to test it, you are in for something of a shock. Push the tune button and you will think you are about to be bitten by a rattlesnake—it sounds as if all the relays are spazzing out, but it turns out that what you are hearing is perfectly normal. You get used to it

quickly and then you will be impressed with what the unit is actually doing.

The AT-11 in operation

This is a nice device to use; it's fast, precise, and reliable. There are finite limits to the degree of mismatch that it will tune, but in practice I suspect that an antenna that can't be matched with the AT-11 isn't going to be much use as an antenna anyhow. Sure, with the right combination of added inductance and capacitance you can "match" a piece of concrete—that doesn't make it a good antenna! In any case, it's probably fair to say that the AT-11 is more versatile than it looks. There is only a single SO-239 coax jack for the antenna output, but that does not mean it will only tune antennas fed with 50Ω coax. If you open up a tuner that has outputs for balanced transmission line and single wire, what do you find? The single wire connection is just connected to the coax jack, and the balanced line terminals are connected to a balun. It's very easy to turn a PL-259 coax plug into a connector for a single wire, and you can always add an external balun either at the back of the tuner, at one of the outputs of a following coax switch, or even outside your shack.

The AAØXI antenna farm consists of a weedy crop of miscellaneous skyhooks, including an R7 vertical, resonant dipoles for 30 and 40 meters, and a shortened all-band doublet fed with 450Ω ladder line. The AT-11 tuned everything perfectly, insofar as it found a better than 1.5:1 match on all the bands I use, with the antennas I normally use for those bands. It also gave me a good match for the R7 on 80m and matched the two dipoles *and* the vertical on six meters!

One minor drawback in shack operation is that the AT-11 will not preserve settings with the power off. That's just a fact of life when you use relays, which after all made the project a lot more feasible, and affordable, than one using motor-driven roller inductors and vacuum variables. And the AT-11 does take some power to run. Momentarily during tuning it is possible for all of the relays to be energized at once, resulting in a current drain of half an amp. A more typical load is 200mA average.

The AT-11 was not the easiest kit I have ever built, but over time I believe it will prove to be exceptional value for money—especially if it performs as well in a mobile or portable environment as it does in the shack.

The LDG AT-11 Automatic Antenna Tuner kit is supplied in several different combinations of board kit, enclosure, QRP/QRO version, factory assembled... too many variations to list here, so contact LDG or check their Web site to see what's available and current pricing. LDG Electronics, 1445 Parran Road, St. Leonard MD 20685. Phone, (410) 586-2177; FAX, (410) 586-8475; E-mail, [ldg@radix.net]; or check the Web site at [http://www.radix.net/~ldg].

Tiny Power

A big little switcher for ATV (or other) uses.

Ron L. Sparks KC5ODM
24818 Lakebriar Drive
Katy TX 77494-1809

I never could pass up a challenge. While my brother and I live in the same state, we are still 400 miles apart. During a recent visit a bit of reminiscing was in order. As children we enjoyed building model rockets. This led to him saying, "Since passing 40, I am now allowed some 'middle age crazy.' The kids and I have gone back to building rockets. Why don't you use your ham radio stuff to build us a payload?" I told him that I thought I could build an amateur TV (ATV) payload if he could give me eight ounces of net weight.

The challenge

This weight would give him a real challenge. Neither of us like the idea of a multiple-engine craft because it is difficult to guarantee simultaneous ignition of the engines. If only one lights you can easily create a "land shark." This is not a pretty thought, especially with a couple of hundred dollars worth of ATV gear in the nose!

Fig. 1 shows the block diagram for the ATV system. As it turned out, the transmitter and camera portions were easy to build. Commercial kits are now small enough to handle these tasks and are reasonably priced. The most unglamorous part became the challenge. To power the CCD camera and a one-watt transmitter about six to seven watts of power supply capability with at least a dual voltage output would be needed. All this had to work from the lightest, most inexpensive batteries available, which led to the following design specifications:

Input	4.5 volts minimum, 12.6 volts maximum
Output	13.8 volts regulated at 300 - 400 mA, plus 9 volts regulated at about 100 mA
Ripple	as low as possible, preferably below 1%
Battery	0.5 to 1 Ah (amp-hour) with a maximum weight of 3 oz.
Power supply weight	less than 1 oz.

A close review of the *Enercel® Battery Guidebook* showed that while lithium batteries have the highest energy density (i.e., most Ah for the least weight) their cost would be prohibitive, at about $11 each. The two remaining choices with high enough maximum current output were alkaline and NiCd. The problem with either of these was getting enough cells stacked for a manageable voltage boost without falling out of the range that an inexpensive regulator could handle. As you will see later the power supply performs flawlessly, but battery weight is still a challenge for the rocket system.

Circuit description

Old-style linear power supply design was as solid and smooth as a diesel engine, and almost as heavy—our new project called for a supercharged high-rpm aluminum race engine. The switching power supply fits this analogy very well. Several years ago they were as complicated to design and use as a race engine. However, technology has advanced rapidly and National Semiconductor™ makes a line of integrated circuits called Simple Switchers®. I looked carefully over their product line with a supplier catalog close at hand, and found the LM2577-ADJ series fit my requirements nicely. The part was small, readily available, and reasonably priced in single quantities from Digi-Key™.

The design process begins with the data sheet. The data sheet circuit proved to be effective in its simplest form. **Fig. 2**, my project's circuit, uses this form with a secondary voltage regulator. The figure also shows component values needed to meet my requirements. The equations to calculate the specific values are not complicated, but they are a bit tedious. National provides design software from their Web site at the URL (Universal Resource Locator) [http://www.national.com/design/index.html], which will save you the drudgery. The program is MS-DOS based, but is solid and robust. Alternately, the equations from the data sheet could be placed into a spreadsheet with the same results. It is very helpful to use one of these computer-assisted methods since several cycles through the calculations are needed to find the optimal balance between weight (e.g., will a heat sink be required?), component size, input voltage range, and ripple.

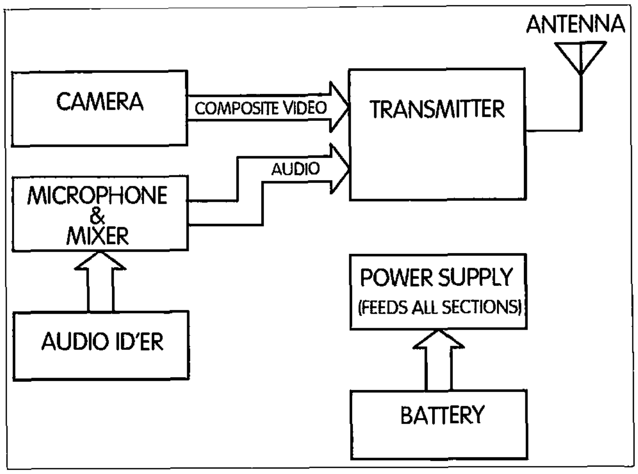


Fig. 1. *Creating an ATV transmitter relies on the power supply.*

of the filtering job. The program provided by National calls this the E.S.R. Unfortunately, most of the manufacturer's specifications for capacitors defined this in terms of dissipation factor—tan δ. The conversion equation is E.S.R. = tan δ/ωC, where ω takes on its traditional value of 2 x π x f (C is in farads, f is in hertz and E.S.R. is in ohms).

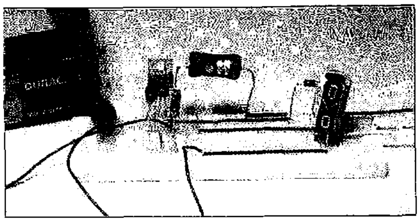


Photo A. *Prototype design is easy on solderless breadboards.*

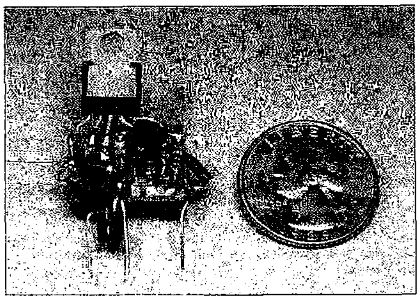


Photo B. *Mission accomplished—seven watts of regulated power the size of a quarter!*

The operation of the circuit is straightforward. An internal NPN switching transistor pulls the junction of the inductor and diode to ground, allowing energy to be stored in the inductor. When a maximum current is sensed, the transistor cuts off, allowing the energy to be discharged and stored in the output capacitor. A divider on this output voltage provides the control to adjust the current maximum required to keep the output regulated.

There are some unusual considerations in the components to be considered. First, the current through the inductor is not a steady state value. This means that the instantaneous maximum inductor current and LM2577 current can be about five times the load current. When selecting the coil, this maximum current must be considered to avoid saturation of the coil core and poor regulation. Also, the switching transients are large. This means that the output capacitor must have a low internal series resistance to handle the high frequency part

In my system this meant that E.S.R. = tan δ/(2πfC) ≅ tan δ/349. Just be sure to select a capacitor with a tan δ that is as low as possible.

Construction

There are no critical concerns for component layout or construction methodology. During the design of the supply you will need to determine whether a heat sink is necessary for the IC, but other than that, any construction approach should be acceptable. In the case of the supply shown in **Fig. 2**, calculations show no heat sink is required, up to a total current of about 425mA and ambient temperatures below 110°F, but the unit will operate very hot. The junction is rated for operation at 257°F (125°C) and the program designs for this. Case temperatures can easily boil water or burn fingers, so use a heat sink if you have room for one.

The circuit was first constructed and tested using the multicontact solderless breadboard system shown in **Photo A**. Once operational specifications were confirmed, the circuit was reconstructed on a Surfboard™ to keep its size and weight to a minimum. The end result is shown in **Photo B**.

How the circuit was moved to the Surfboard deserves a few comments. Each point of connection on the schematic was labeled with a node letter and then a table was constructed with each node and the components connected to it. Using this table allowed the circuit to be redrawn into a configuration that fit the Surfboard with a minimum number of jumpers; the result is a very compact package, weighing only 1/3 ounce (9.5 grams). The quarter in the photo weighed 1/4 ounce (7 grams).

Testing

Your testing will probably only require basic voltage checks on the output. Just be sure to put a power load resistor on the output so that the supply is at least minimally loaded during testing. I wanted to perform a more thorough test for this project, however—with two objectives: First, it was important to verify that the supply was operating properly and was stable throughout its input operating range. Second, an estimate of battery life was needed.

Fortunately, DMMs have now become

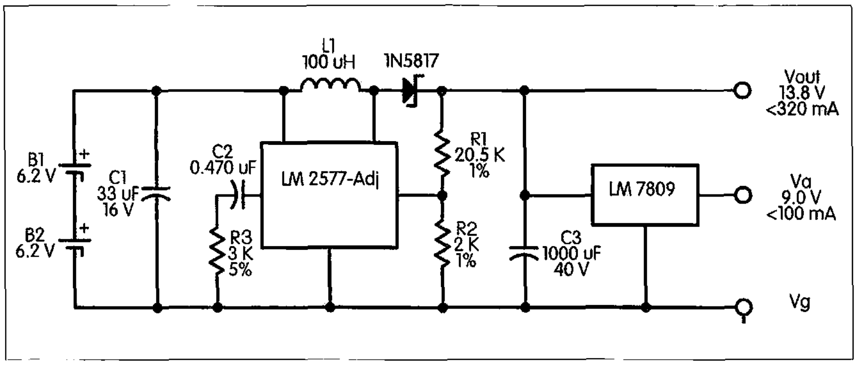


Fig. 2. *Putting it all together into a workable circuit.*

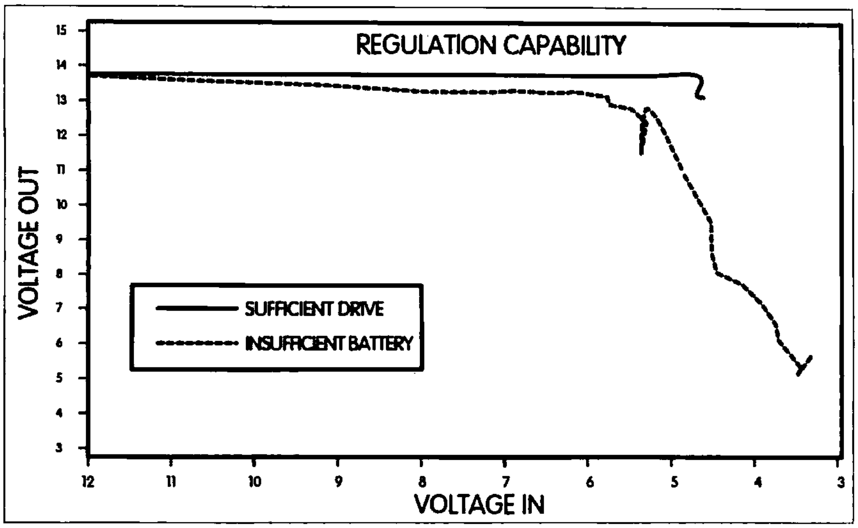


***Fig. 3.** A good battery is essential, but this little supply can deal with nearly anything.*

so inexpensive (under $20 each) that I had enough to monitor input voltage, output voltage, and output current simultaneously. **Fig. 3** shows a plot of input voltage versus output. This was performed with a 100mA load on the 9V output and a 325mA load on the 13.8V output (a total of 425mA on the supply). Input was from two Duracell® size "J" alkaline photo batteries wired in series. You can tell from the curve that things took an unexpected turn at this point. When loaded with a 10% load (35mA), everything operated perfectly. However, with the full load applied, the input current demand was so high that the batteries could not meet the demand. This led to an interesting investigation of batteries (see **Sidebar**). When larger batteries were used, the system worked as desired.

The curves show that the circuit was regulating well within design requirements down to a battery voltage of

Parts List

C1	33µF, 16V electrolytic
C2	470nF, ceramic
C3	1,000µF, 40V electrolytic with low E.S.R.
L1	100µH, 2.5A peak current inductor
R1	20.5kΩ, 1% surface mount
R2	2.0kΩ, 1% surface mount
R3	3.0kΩ, 5% surface mount or 1/8W
D1	1N5817 or equivalent Schottky Diode (1.0A, Vmax = 20V)
U1	LM2577T-ADJ National Semiconductor switching regulator

Optional, but recommended:

Heat sink for U1	23°C/W or better

Surfboard™ circuit board

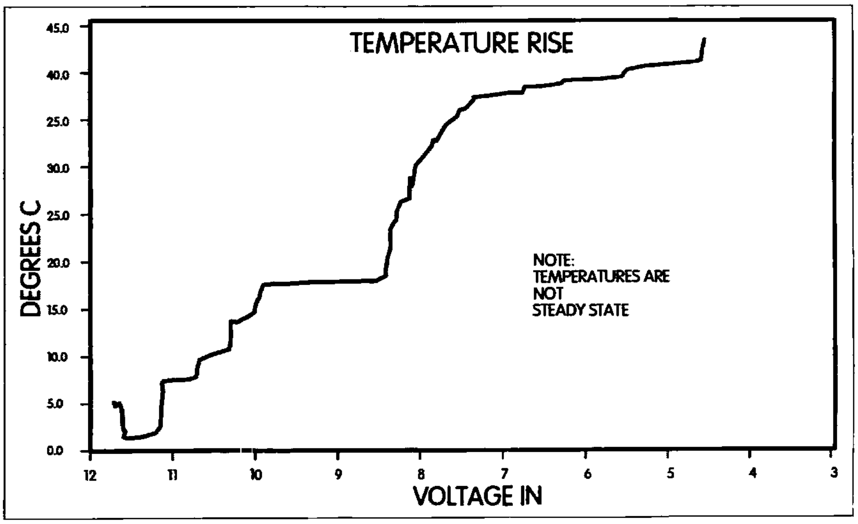


***Fig. 4.** Use a heat sink when you can, and don't burn your fingers.*

4.2V and then degraded "gracefully." An oscilloscope was placed on the output throughout the test and showed no peculiar changes or transients throughout the testing. There was, however, a high frequency switching spike on the output. Depending on your requirements, further filtering or shielding might be necessary.

Fig. 4 shows the regulator case temperature versus time. From this you can see that the power dissipation through the switcher is greatest toward the end of battery life when the boost requirement is the greatest. This may make a difference depending on your application.

Results

As you can see from the testing, all of the specifications were met successfully. The total final weight was 0.33 ounces (9.5 grams). The output voltage stayed at a stable 13.8V down to an input voltage of 4.3V (when given sufficient input current). The best result of all is that I not only have a useful power source for my MicroATV system, but I am no longer bothered by the thought of designing a switching power supply. Now if my brother could just give me another half-ounce or so of weight I could possibly squeeze in a video IDer, but that's another challenge... hmmm. 73

A Battery Tale

During the testing of the power supply, I was forced to learn (or is it re-learn?) a few lessons about batteries. The first thing to remember in any boost-operating regulator is the old adage of "no free lunch." The power in must be greater than the power out. For example, that means that even if the regulator is nearly 100% efficient, the input current at 6 volts has to be greater than 1 amp to provide the rated output (13.8 volts @ 425mA).

The *Enercel® Battery Guidebook* is an excellent source of information on small batteries. This book showed the size "J" batteries to be rated at 0.55Ah (amp-hours). I knew that batteries are rated for a 10-hour discharge rate, but I expected their performance to be reasonably linear. The most common model for battery calculations is a pure voltage source in series with a resistor. That resistor is called the internal resistance of the battery. If a battery were perfectly linear, that resistance would be the same for any discharge rate. Using such a model implies that the "J" battery could put out about 1.1 amps for 30 minutes (1.1A x 0.5h = 0.55Ah). What I discovered was that for discharge rates less than the nominal 10 hours, the nonlinear behavior was severe. The life of the "J" batteries at those extreme loads was measured in seconds, not minutes! Based on this result, the battery size had to be increased to a 10Ah camcorder battery to test the supply at full load. This is too heavy for the rocket, so we are still searching for alternatives.

I think it would be an interesting project to run a series of discharge tests and calculate the change in internal resistance for various battery types. This would determine just how much we could push certain types of batteries. I suspect that similar characteristics will exist in each family type (nickel-cadmium, alkaline, lithium, etc.). If any of you have done tests like this, I would be interested in knowing the results. Better yet, find a student and help him/her make this into a science fair project—we would all benefit from that.

Finding His Voice

Two young women found an urgent need for CW skills.

Jennifer Sanders
with Jacqueline Sanders KB6MTV
320 Camino Al Barranco
LaSelva Beach CA 95076

In 1983, when my sister and I were young girls (I was around 13 and my sister Jacqueline was about eight), my father, Jack, began to teach the two of us Morse code. He had just earned his General class amateur radio license (KB6MLO) and he felt that it was never too early to start teaching his children. At the time, the two of us had no idea how important learning Morse code would prove to be later on in our lives.

We come from a family of hams. Both of my father's parents earned their amateur radio licenses in 1956 while living in the Panama Canal Zone. My dad's father, Bruce G. Sanders, Jr., started out with the callsign KZ5SS, and his mother Dorothy's call was KZ5SN. At the time, the KZ call was used only for Panama Canal Zone residents. After they retired and moved to Arkansas, their callsigns changed to WA5NUP and WA5NUQ.

My father did not earn his license until years later, around 1982. He started out with the call KB6MLO and quickly raced through to getting his Extra class license and a new call, WX6X. He became very involved in amateur radio and eventually became the president of his local amateur radio club in Santa Cruz, California, in 1988. He was very active and interested in getting the community, especially the younger generation, involved in amateur radio. He felt that amateur radio plays an important part in the community. He and my sister Jacqueline both operated the emergency ham radio frequency for Red Cross emergency communications during the days immediately following the Loma Prieta earthquake in the San Francisco Bay area in 1989.

During my father's most active amateur radio years I was a teenager, and though I learned the basics of the code, I never completed my training and did not earn a radio license. At that age I felt that there were other, more important, things to pursue, whereas my sister at age eight picked up the code and the theory quickly and began studying for her Technician license (this was before there was a "No-code" Technician).

Way back then, I felt, as many people do today, that Morse code was an archaic thing to be learning. I am a child of the computer age and learning something so primitive seemed ridiculous. What was I ever going to use Morse code for in an age where FAX machines and cellular telephones are so common? Luckily for my sister and me, our father did not think that the code was so outdated. He stressed that the code still had its place, and I learned the basic dits and dahs of the code alphabet. My sister became very proficient with Morse code, studied hard, and went on to earn her Advanced license at age 10 (KB6MTV) while my father earned his Extra.

Our father had moved to Florida to continue his education and was working on a Ph.D. in Computer Technology in Education. He still had been using ham radio, although much less frequently, and he still knew Morse code. In late 1996, he was to put his Morse code knowledge to good use.

On Sunday, December 15, 1996, Dad was riding his motorcycle home in Sarasota after completing his Sunday afternoon ride with a few of his friends,

Photo A. *Jack Sanders WX6X using a practice key to send code to his daughter Jacqueline KB6MTV.*

when a car pulled out of a driveway 25 feet in front of him. As always, my father was driving carefully and wearing the usual protective gear: a Bell approved helmet, leather jacket, and leather boots. He slammed on his brakes, but he did not have enough time to avoid the car. His head hit the bottom fender of the driver's side of the car as his motorcycle slid on its side.

He suffered massive fractures to his face, especially the right side, and broke three vertebrae in his neck. He was airlifted by helicopter from the accident scene to Bayfront Medical Center, about 40 miles away in St. Petersburg, where he was admitted in critical but stable condition, and was placed on a life supporting respirator.

He underwent a 10-hour brain and facial surgery on December 19, 1996. He had facial reconstructive surgery, his jaw was wired and he was given a tracheotomy. His right eye was so damaged from the impact of the accident that it could not be saved and unfortunately had to be removed. Thankfully he suffered only minor brain injury and came through the surgery well.

This began a nine-day stay in the intensive care unit while he recovered from his surgery. He appeared to be doing well, and the doctors told my sister and me that he was progressing normally. The problem was that although my father was coherent and conscious, he could not communicate because his jaw was wired shut, and the respirator that pumped air to his lungs through a hole in his throat made it impossible for his vocal cords to work. He could not see out of his left eye because his face had been so severely injured that the eye was still swollen and his vision was extremely blurry. The injury to his neck had made his upper body, especially his hands, incredibly weak; it was impossible for him to hold a pen or pencil.

My sister and I began to think about how we could communicate with our father. He was essentially in the dark and unable to communicate with us or his doctors and nurses. He could squeeze our hands to reply "yes" or "no" to any of our questions, but he was unable to tell us anything.

Then we remembered Morse code. My sister is not an active ham and had not used the code in quite a while. I had not used it in about 13 years, but we decided that if our father could send it to us, then we would force ourselves to remember.

We bought a practice key at a local amateur radio shop and brought it to the hospital. My sister put the key underneath my father's right hand, placing his index finger on the key pad and asked, "Dad, do you think that you can send us Morse code on this key?" He sent back ".. -.-. .- -.". Once I heard his "voice" through Morse code, I knew he was going to be okay.

Within a few days, my father was strong enough to send code steadily. It was an incredible relief for him to be able to communicate and it was wonderful to know what he was thinking. In no time he was sending pages and pages of code.

He was moved to a regular room for further recuperation. He still was using the key to communicate with us, but since none of the nurses or doctors could understand Morse code, my sister and I took turns staying with him around the clock to translate and assist him. He always had the Morse code key by his side, night and day. Hospital personnel would hear the noise from the key as they were walking down the hall and come into the room to find out what was going on. We received many enthusiastic comments on what a brilliant, helpful method of communication the code was. We were definitely the talk of the nursing staff.

My father was moved to Health South rehabilitation hospital in Sarasota FL on January 13, 1997, and is now able to speak again. Since that time he has often mentioned that Morse code really saved him. He says that before he was able to communicate he was frustrated, scared, and alone in the dark in his hospital bed. Whenever he mentions those times I think about how very scared I was until we tried using the code—and how much of a difference it made in all our lives. 73

Bicycles Across Switzerland

QRPing through beautiful Switzerland by bicycle is a blast!

Stephen Stuntz NØBF
P.O. Box 1462
Loveland CO 80539

I arrived in Zürich on August 30, 1996, with a home-brew 30-meter CW transceiver (designed by NN1G), a 2-meter Standard C108C handheld, and an HP-2001x palmtop computer (to send CW). Both radios, and the palmtop, were powered with AA batteries. The 30-meter dipole, made with thin wire and RG-174 coax, was stored on a cardboard toilet paper roll by tucking the coax inside and wrapping the wire outside. The Swiss PTT government agency had mailed the temporary license, HB9/NØBF, to Loveland 2 months earlier, thanks to the assistance of the ARRL.

We took a bus south to Einsiedeln, a picturesque winter vacation village with cobblestone streets leading through the town center to an old abbey. We spent the morning adjusting to the 8-hour jet lag: shopping, resting, and touring the 16th-century abbey, with its paintings, stained glass windows and a beautiful black stone Madonna. After a delightful lunch, several of our group headed to the hotel, overlooking the abbey, for a nap.

Photo A. Author operating at hotel in Boningen. (All photos courtesy of author.)

In the afternoon I spent half an hour setting up a 30-meter antenna from my second-story balcony, by uncoiling each leg of the dipole off of the cardboard tube. The tube was taped to the balcony railing and each leg was attached to trees below, in an inverted vee configuration. Each leg was installed by tying one end of a length of fishing line to the antenna and the other end to a small lock. After tossing the lock off the balcony, I went outside, found the lock, pulled the dipole leg taut and tied the fishing line to a tree limb or fence post. The RG-174 coax was pulled out of the cardboard tube, uncoiled, and routed through the balcony door to the NN1G.

After connecting the headphones and the palmtop CW keyboard, I tuned around looking for some hams, but only heard one loud commercial RTTY signal on 10.110 MHz. Sending a CQ on the palmtop didn't result in a response, so I turned on the C108C and scanned 2 meters with no luck. Feeling disappointed, I headed downstairs to pick up my bike and prepare it for the next day's trip to Rapperswil.

The next morning Herman, our Dutch bicycle leader, yelled out "on your biiiiiikes!" as he hopped onto his bike from a running side leap, to lead our group over the breathtaking foothills to Zürichsee (*see* means lake in Switzerland). On descending hills overlooking Zürichsee, I pulled the C108C out of my pannier and scanned 2 meters. The

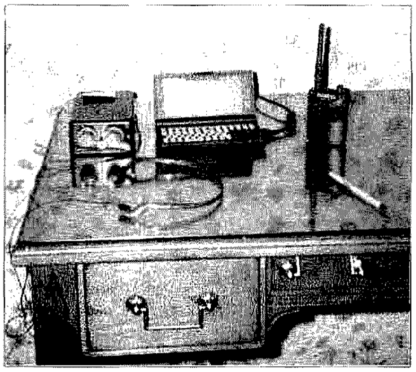


Photo B. Ham gear on Fribourg hotel desk.

miniature handheld stopped scanning in a full quieting QSO spoken in German. Jim NØGTW, who had stopped to interpret, heard the two voices say "have a good day" before they signed off. We couldn't key the repeater, so we hopped back on our bikes, to catch the rest of our group, who had disappeared down the trail.

That afternoon, after we returned to Einsiedeln, I packed the 30-meter station into a backpack and headed up a steep grassy hill in back of the abbey. The trail meandered through pastures where sheep and cattle grazed, making beautiful music as the bells on their necks rang. After a steep ascent I stopped where the trail passed by a tall statue of a monk. The geometry was perfect—and irresistible. I strung together a sloper antenna by draping one leg from the arm of the statue and attaching the other leg to a picnic bench below. A group of singing nuns walked up, sat on the bench, and began a prayer meeting around the statue that I was using as an antenna support!

Embarrassed, I sheepishly repacked the antenna and headed up the trail for a second try, to another picnic area under a tree. The 30-meter band was in the same lousy condition as on the previous night except for a loud commercial RTTY station. It started to pour just as a faint CW signal from England appeared on 10.120 MHz, so I scurried back to the hotel.

"A group of singing nuns began a prayer meeting around my antenna-support statue!"

The next evening we arrived in Beckenried for a one-night stay. Still optimistic, I set up an inverted vee and scanned 30 meters. The band was alive with signals coming in from all over Europe, but I was unable to strike up a QSO. I also scanned 2 meters but didn't hear a soul.

We pedaled to Bönigen, nestled at the foot of the Eiger, Jungfrau and Monk mountains near Interlaken. On September 3, in this picturesque valley on the crystal-clear Brienzer See, where the elevation changes from under 1000 feet to over 13,000 feet in a few miles, I finally worked several stations.

Ras HB9ACV gave me a full quieting report from Burgundy, France, on 2 meters, from the shore of Brienzer See. Ras told me that he had moved from Switzerland to France 5 years ago but had not changed his callsign because of the retesting involved. The repeater that Ras and I used must have been placed high in the Alps to provide such excellent results with only 200 milliwatts! Later, I answered HB9O in Lucerne to ask about the location of the repeater and he asked, "*Sprechen sie Deutsch?*" I had to answer, "No!"

Back at the hotel I was feeling discouraged about my inability to communicate on 30 meters and didn't feel motivated to set up a neat antenna installed with fishing line away from the building. Instead I tossed the hot dipole leg out the second story, over a tree limb, and dangled the shielded leg out the window against the hotel to the ground. This configuration looked more like a tilted teepee rather than an inverted vee. At 9:30 PM, Ole OZ5DL, in Copenhagen answered a CQ keyed from the palmtop on 10.105 MHz, in spite of the unusual antenna configuration. He gave me a 569 signal report, said "73," and began chasing DX. Next I received a 549 report from Gunar YL2PG, of Riga, Latvia, on 10.110 MHz. Gunar was transmitting 100 watts into a dipole. I felt more confident after completing the QSOs because it seemed obvious that previous difficulty communicating on 30 meters was due to poor propagation and not operator error.

After leaving Bönigen, our group pedaled south to Bern, the capital of Switzerland. On the main street, between the river and the old city gate (built in 1200), stood Albert Einstein's house, where he lived and worked as a patent clerk, as he developed the Special Theory of Relativity. I paused there, feeling a sense of awe, thinking of how he had increased the understanding of physics, including radio waves used by ham operators all over the world.

From Bern we pedaled further south to Fribourg. On September 7, I put the C108C in the backpack and went shopping in the town square. At 5 PM, on top of a hill, I scanned 2 meters and found a repeater on 145.65/.05 MHz, busy with QSOs spoken in both French and German. Heinz HB9AGB, in Bern, responded to my call and explained that the repeater was located in the Alps North between Bern and Fribourg. He also explained that German is spoken by people living north of the repeater and French is spoken by the people living south.

At 8:10 PM, Jan SP2EXE, from Wejherowo, Poland, gave me a 569 signal report on 10.112 MHz, using the same teepee antenna configuration that

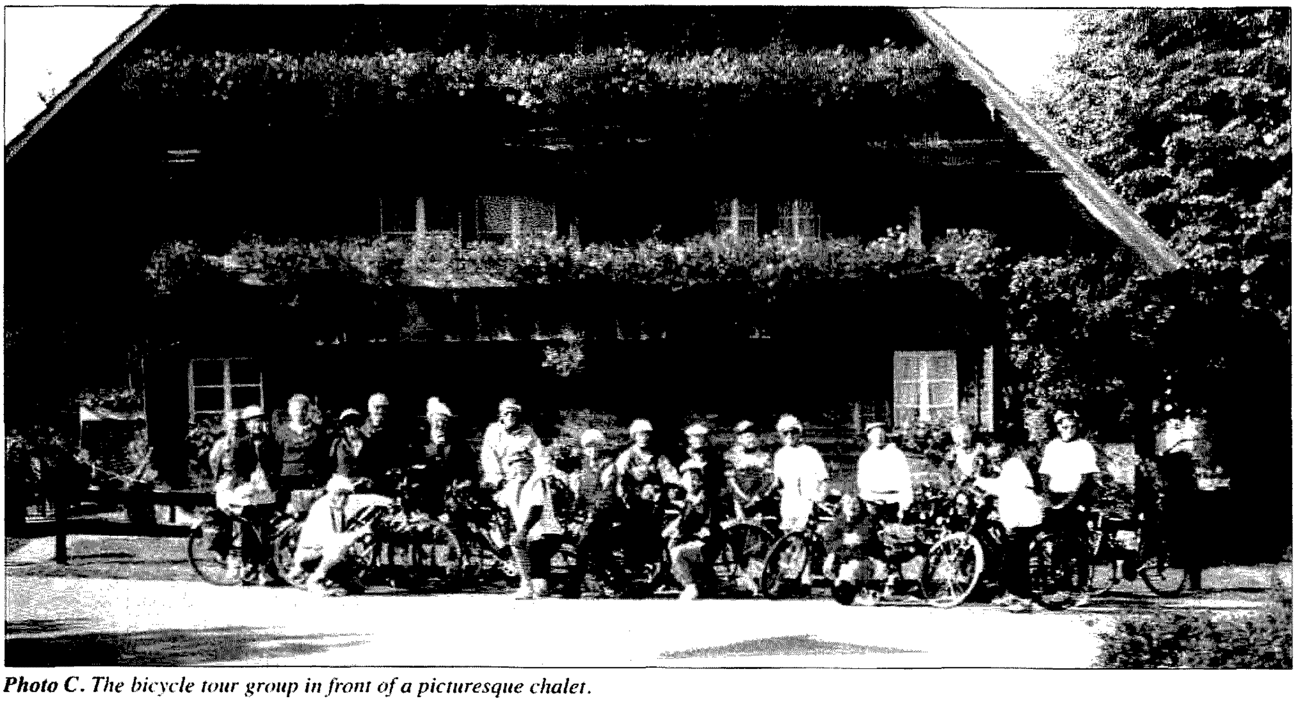


***Photo C.** The bicycle tour group in front of a picturesque chalet.*

had worked in Bönigen. At 9:30 PM I answered Roy GW3SYL, in Bridgend, England, on 10.105 MHz, as he was signing off. He gave me a 579 report and stayed on the air for a few minutes because he wanted to hear about the QRP setup. I was surprised at the strength of my signal report because the NN1G power output was falling below half a watt due to low battery voltage. With no plan to recharge the batteries, I decided to pack the 30 meter rig away for the remainder of the trip.

On the final leg of the trip we pedaled through the Gruyère Valley to Montreux on the northern shore of Lake Geneva, the area known as the "Riviera" of Switzerland. I was not able to contact any hams in Montreux because the C108C receiver was overloaded due to cell phone transmitters.

On September 11 at 5:00 AM, our group boarded the bus to the Zürich airport, and by 7:00 PM we were back in Denver. As soon as I arrived home in Loveland I got on 2 meters and notified my friends in the Colorado QRP Club of the contacts I'd made in Switzerland. They reported that the HF conditions had been lousy and they were surprised that I had made any contacts at all. I shared my pleasure in communicating successfully with a simple antenna tossed out the window. They reminded me that the ability to communicate on HF is affected more by the condition of the ionosphere than it is by the quality of the antenna.

Next, I sent an E-mail message to Gunar, and 10 minutes later he responded from Latvia! He explained that he worked for the FCC-equivalent government agency in Latvia. A few days later I received a picture QSL postcard from Riga.

I am planning to bring ham radio along on the next Colorado Mountain Club bike trip to Italy. Some of the preparations include:

1. Applying for a reciprocal license. (Hopefully, ARRL/FCC will be successful in achieving reciprocal licensing, eliminating the need for a temporary license.)
2. Considering 40 or 80 meters until the solar cycle picks up.
3. Taking along a bicycle mobile whip antenna.
4. Learning to speak some Italian; getting on SSB instead of CW.

Photo D. Author's favorite bike trail, in the Alps looking toward the Gruyère Valley.

Bill Brown WB8ELK
139 Angela Dr. Apt. B
Madison AL 35738
E-mail: [bbrown@hiwaay.net]

Last February 22nd, members of the HALO (High Altitude Lift Off) group gathered at the old airport in Huntsville, Alabama, to launch their latest balloon experiment. This was a test of the uplink and command module for a future rockoon (rocket launched from a balloon) flight.

The experiment

The payload, designed by Ed Myszka KE4ROC, consisted of a live color TV camera (from North Country Radio) that pointed down at the Earth below and also at a series of experiments that could be seen in the camera's field of view. Four experiments were visible: a red LED connected to one of the command channels, two rope cutter mechanisms and a small model rocket. The idea was to activate each of the experiments via a 2m touchtone uplink command and a custom touchtone controller board that Ed designed using a CM8880 DTMF decoder IC by California Microelectronics. The ATV transmitter was a PC Electronics KPA5-F and the antenna was an Olde Antenna Labs Mini-Wheel.

In addition to the ATV system, Ed included an APRS-formatted packet downlink on an Alinco DJ-180 tuned to 145.79MHz using a PacCOMM Pico-Packet Companion GPS board and a MIM packet module. The MIM board [available from Clement Engineering, (410) 268-6736] actually takes in the serial data from the GPS board and converts it directly to packet data.

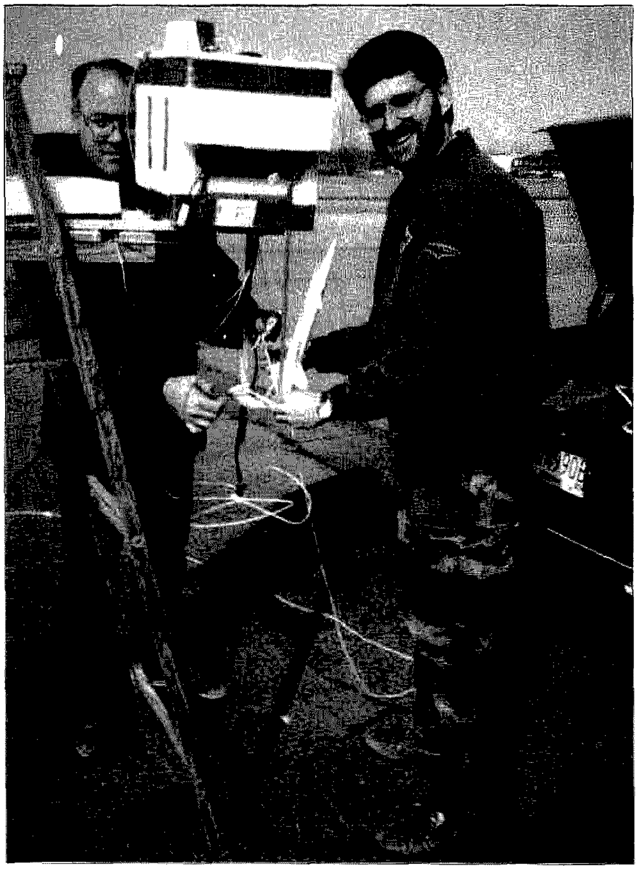


Photo A. *Al Wright (left) and Tim Pickens of the HALO group prepare the ATV balloon payload for flight.*

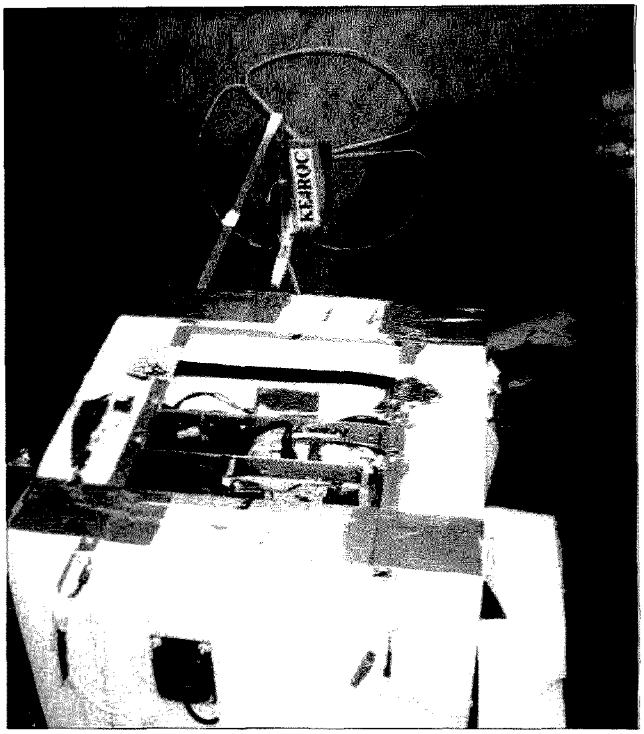


Photo B. *Close-up view of the balloon payload. Note the generous use of the scientist's secret weapon—duct tape.*

In a separate package, I made up a very small 10m CW beacon on 28.322MHz (20 milliwatts) that would transmit for at least two weeks.

Ups and downs

Gene Marcus W3PM and Ed KE4ROC set up their ground station on picnic tables underneath a shelter. Inflating the balloon was a bit tricky due to high winds, but we were finally able to string everything together and prepare for liftoff.

Even with the high winds, we had a picture-perfect liftoff as the balloon headed off to the stratosphere. Ed had a microphone on the side of the package hooked up to the ATV subcarrier and it was quite fun to hear our cheers of excitement downlinked from the balloon. It was neat to listen to the microphone audio. Cars and dirt bike noises could be heard by the balloon package from several thousands of feet of altitude. On one occasion we could hear a distant jet engine as well.

The jet stream was quite strong that day and the balloon quickly drifted toward the east and Chattanooga, Tennessee. At times the balloon was traveling over 150 mph.

At 80,000 feet, we decided to fire off the experiments. We could clearly see the red LED turn on and off when we hit the proper touchtone sequence. One of the rope cutters fired off as well. Unfortunately, the other cutter and the model rocket did not fire off.

The balloon popped at 90,000 feet over the eastern part of Chattanooga and parachuted down to land in a heavily forested wilderness area near Lake Ocoee, very near the site of the Olympic kayak races. The APRS GPS data worked well, but many participants had difficulties receiving the signals. It turned out that the radio had its 5kHz offset turned on, which made it difficult to receive. Nevertheless, we had good position data down to the last 7,000 feet. This helped to narrow down the search area to within a mile, but a mile in the wilderness is not quite the same thing as a mile in a cow pasture, let me tell you!

The search

Trying to play catch-up with a balloon traveling 150 miles per hour was a challenge, but the chase crew that left the launch site (Robby Sperr KF4LFQ, Patrick

Bramlett KE4QIC, Jared Cassidy KQ4VT and Chris Richardson N9QVI) closed in on the payload with help from Bill Nolle WA8INZ, who relayed coordinates to the team via HF and APRS. They were in a remote mountainous region and finally gave up the search after tromping through the woods for several hours in the dark. They were receiving weak signals from the payload, but could not pinpoint its location. Over the course of the next week, Rex Wagner, a relative of one of our team members, was able to see what he thought was an orange parachute dangling from a treetop on a ridge about two miles from the overlook where he was standing, but was unable to figure out just how to get to it.

With this information in hand, I headed out to the area the next weekend with Greg Allison, Chuck Grazioli, Ralph Fowler N4NEQ and Eddie Foust WD4JEM. Ralph and Eddie had an impressive array of DF equipment at their fingertips and spent the afternoon taking readings from many locations surrounding the payload.

At first I tried to find a road that would get us close to the payload, but when I saw the house at the end of the road—with trash scattered everywhere, pit bulls roaming free and the stuffed dummy (at least I hope it was a stuffed dummy) hanging from the tree limb—I decided that hiking in through the woods was a better choice!

We hiked in as far as we could while tracking the very weak (about 0.2 milliwatts) 2m harmonic from the 10m beacon. Greg hacked his way through the terrible web of brambles with a machete. It was incredibly slow going and we were all slashed up by the thorns at the end of the day. Just at sunset we finally got a very strong reading and realized that we were probably only a few hundred feet away. It was difficult to turn back at this point, but we didn't want to get stuck in the wilderness in the dark.

We met up with Ralph and Eddie and narrowed down our search area with their DF data. It appeared that we were only 400 feet away when we had to turn back. Ralph had an interesting encounter with one of the local store owners during their search. He had this tale to relate about their search:

Late in the afternoon, Eddie and Ralph piled out of Eddie's Trooper at a small grocery store and began using the hand-held VHF beam to take additional bearings on the package. This was to be our best bearing from the southeast side of the landing site. The lady working in the store wanted to know what we were up to...

"Looking for the Energizer® Bunny?"

"Yes, ma'am," Ralph replied. Then he told her what they were really doing.

She said (clueless as ever), "Well—I have lots of Energizers in here, but I think they're all turned off." Ralph and Eddie shook their heads and said the only thing they could in this situation:

"Well, ma'am, as long as he's out there, we'll be out here looking."

The recovery

As we headed back home that evening we talked to two of the local hams on the repeater, Joel Gamble KO4QC and John McClary KD4AFW. Even though John was 15 miles west of the landing site, he tuned in to the 10m frequency and had an S-9 signal from it! They were so excited about the prospect of finding a balloon package that Joel headed out with his friend Rusty Boling AE4BK over the next two days. As Rusty provided him with DF bearings, Joel finally found the package just a few hundred feet south of the point where we'd given up the search. It was 90 feet up in the tree and the model rocket was lying on the ground below it. Meanwhile, Tim Pickens and Gene Young K4ZQM, of our HALO group, had headed into the woods with a long pole and a three-wheeler motorbike. They encountered Joel and Rusty as they were on their way out. With their directions to the tree and by DFing the transmitter with an HT, Tim and Gene were finally able to reach the site and rescue the payload after it had been in the woods for nearly 10 days.

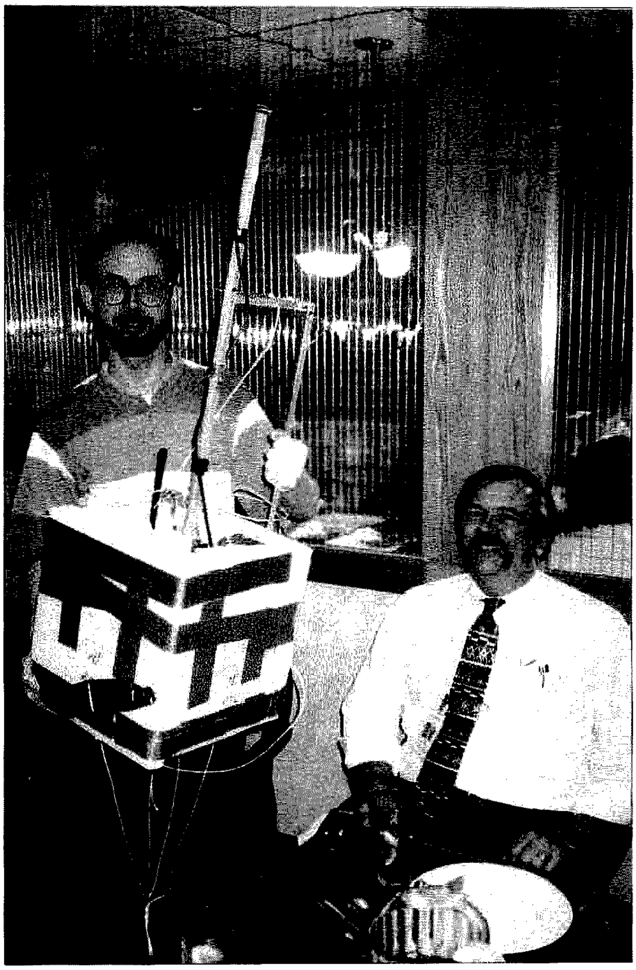


Photo C. *Clay Sawyer (left) and Ed Myszka KE4ROC inspect the recovered payload.*

When Tim and Gene stopped back at the grocery store at the trailhead, the owner told them, "I didn't want to scare you fellers during your search in the woods, but look at some of the critters we hunt back there." What followed was page after page of photos showing 400-pound black bears and sharp-tusked wild boars. We decided it would not be a good idea to land in the wilderness anymore unless we could take Daniel Boone with us.

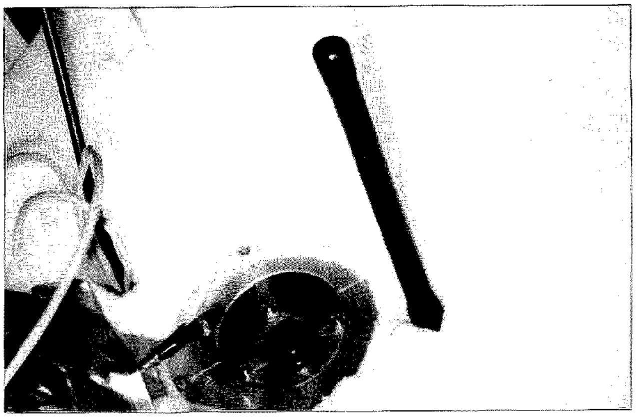


Photo D. *Close-up view of the TV camera lens and plastic cover assembly.*

Number 52 on your Feedback card

Homing in

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
E-mail: [Homingin@aol.com]
Web: [http://members.aol.com/homingin/]

Follow the fluxgate

"Has the bearing shifted?" I wonder how many hundreds of times I have asked that question of my navigator when I've been driving on a mobile hidden transmitter hunt (T-hunt). A sudden change of bearing means that you are getting close and it's time to pay more attention to cross streets and side roads. A few seconds of inattention at this point could result in passing by the target. On a first-finder-wins hunt, you will lose valuable minutes while trying to find a turnaround. On a hunt scored by odometer mileage, one slip could mean the difference between first place and a much poorer showing.

Along straight city boulevards, it's easy to detect a small shift in the bearing as you swing your two-meter yagi or quad. The usual pointer-and-compass-rose indicator on the mast bottom is all you need. But what about those meandering streets through new residential neighborhoods? In my area, they are seldom straight or aligned to the four major compass directions.

Worse yet are roads through canyons and over ridges. Even though it is necessary on a large percentage of hunts starting here in Fullerton, I used to dread going over the hills from Orange County to the San Gabriel Valley on Fullerton Road or Hacienda Road. The hidden T might be in the hills or over the top. It's hard to tell which when the signal suddenly gets strong, because of the many twists and turns of the road. There is no place to pull over on these two-lane highways and you are subject to horns and curses from drivers behind you if you slow down to less than the legal limit.

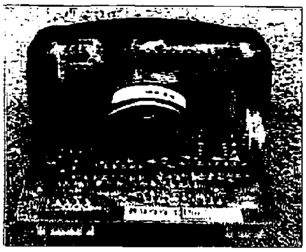


Photo A. The LiteOn DCS 800 automotive fluxgate compass can be used to display the position of your mobile beam antenna with respect to true north.

I longed for an indicator that would continuously show mast orientation with respect to true north, instead of just relative to the vehicle heading. With it, I could quickly detect bearings shifts no matter how much the road curves. Let's see, a shaft encoder could detect mast position, vehicle heading would come from a digital compass or GPS unit. Then I would have to put it all together with a dedicated computer and write a program to display it. Wait, there is a much easier way! Just put a remote compass sensor on the hand-rotated antenna mast! It directly senses beam heading with respect to north and displays it as the beam goes around.

An inexpensive solution

Several southern California T-hunters, myself included, have used Radio Shack™ automotive compasses as remote mast indicators for five years or so, in addition to the usual mast pointer. I have not written about it in this column because the model we use has long been discontinued by the Shack and was thought to be unavailable. With help from N4NEQ, KE6DKF and others on the Internet radio direction finding (RDF) mailing list, I recently found out that this device is still being manufactured by the company that designed it, LiteOn Automotive of Memphis TN.

The model DCS 800 automotive compass (**Photo A**) uses fluxgate technology to sense the Earth's magnetic field and display the sensor orientation on a rotating disc that you can mount in plain sight of all T-hunters in the vehicle. It is available for less than fifty dollars from J. C. Whitney™ Automotive Supply. You may also find it at your local recreational vehicle supply store.

The heart of this device is a small sensor cube, only 1 x 1 x 0.75 inches, weighing less than an ounce (**Photo B**). It consists of a toroidal (doughnut-shaped) core of high-nickel steel or ferrite material with three windings on it. The bottom (control) winding goes around and around through the hole of the doughnut and covers the entire surface of it. A 2kHz square wave is impressed on the control winding, causing the core material to go into and out of saturation at one magnetic polarity, then the opposite, and so forth.

Two orthogonal (oriented at 90 degrees from one another) sense coils are wound over the core and the control winding, not passing through the center hole. If there were no ambient magnetic fields, the alternating saturation flux lines within the core would always cancel and no current would flow in the sense coils. But Earth's magnetic lines of force are "pulled into" the high-permeability core each time it leaves the saturated state. This induces momentary current pulses from the two sense coils in proportion to the orientation of the Earth's field relative to each.

When suitably processed, amplitude and phase values of the sense coil signals are sufficient to determine the exact orientation of the horizontal component of the Earth's field—in other words, a compass reading. The two processed signals are called sine and cosine (sin/cos) outputs because they create sine waves 90 degrees out of phase from each other as the sensor is rotated in azimuth.

Note that the toroid core must remain oriented with its central axis exactly perpendicular to the Earth's surface in order to sense only the horizontal component of the Earth's field. The compass sensor rotates around this axis as bearings are taken. Any tilt of the axis from perpendicular causes pickup of vertical components of the field, resulting in bearing errors.

In the LiteOn compass, a special motor (resolver) turns to display the heading described by the sin/cos signals (**Photo C**). It has two orthogonal coils within, one for each signal, and a display shaft with a magnet on it. Even though it turns freely when power is off, response of this resolver in operation is somewhat "lumpy" or "sticky." That is, it does not react accurately to small (less than 20 degree) changes in direction and it has some backlash. Normal vibration of the vehicle helps overcome this characteristic.

Fluxgate compasses with precise digital readout and no backlash are available from Autohelm™ and KVH™, but they are considerably more expensive. Their automatic compensation features are not suitable for use on a rotating mast atop a moving vehicle. Besides, the analog mechanical disc of the LiteOn compass is far easier to read than a digital display when the sensor is attached to a manually turned RDF beam on a winding road.

Put it to work

The sensor and display are connected by a 10-inch five-wire cable. J. C. Whitney sells a 3-foot extension, but you can easily make your own from ordinary ribbon cable. Mine is six feet long.

There are three important factors to consider when you mount the fluxgate sensor on your RDF antenna. First, beware of the magnetic effects of your vehicle's body. At first, I was more concerned about the five-wire cable

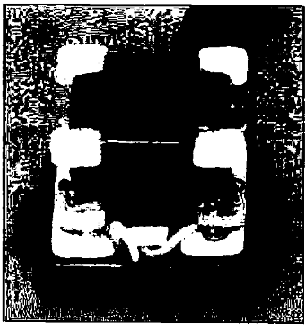


Photo B. The fluxgate sensor is smaller than a ping-pong ball. With the cover removed, you can see the sine and cosine windings crisscrossing the top and bottom, covered with tape.

upsetting the operation of my RDF quad, so I mounted the sensor to a bracket on the side of the mast below the antenna, about nine inches above the roof. Accuracy and repeatability of the indications were poor. When I calibrated the sensor around the azimuth circle with the van heading east, the readout would be wrong when I was driving west. I moved the sensor to the top of the PVC mast, 28 inches above the vehicle roof. This solved the inaccuracy problem. The cable going down the mast through the quad has not affected the antenna's directional pattern.

Second, be sure that the bottom of the sensor remains level in operation. Mount it so that there is no tilt forward, backward or to the side at any setting of the mast. Any tilt will cause error due to pickup of vertical components of the Earth's field.

Third, remember that map plotting is far simpler with true bearings than with magnetic bearings. As you probably know, a magnetic compass does not seek out the geographical north pole. It is attracted to the magnetic north pole, which is near Hudson Bay in far northern Canada. To USA residents, this means that unless you live along a line from Indiana though South Carolina, you must correct your magnetic compass indications in order to have bearings relative to true north for plotting on standard maps.

Hams throughout Florida have only about two degrees magnetic declination, as this effect is called. If you are in northwestern Washington or northern Maine, the error is about 24 degrees—quite significant. You can find the magnetic declination where you live from a United States Geological Survey topographical map of the area.

Here in southern California, declination is about 14 degrees east, which means that 14 degrees must be added to magnetic compass readings to get headings relative to true north. If you live to the east of the zero-declination line, your declination is westerly and you must subtract the declination value from magnetic bearings to get true bearings. Fortunately, it's easy to mount the sensor so as to automatically compensate for the magnetic declination in your area. I did it by canting the sensor 14 degrees clockwise on the mast, as shown in **Photo D**.

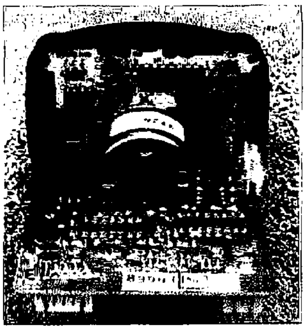


Photo C. Rear view of the DCS 800 display with the cover removed shows the two circuit boards. The round object in the center is the air-core resolver.

A better display

"Stickiness" and backlash are artifacts of the resolver only. The sin/cos signals are delayed by integrator stages, but they follow directions quite accurately. You can readily extract these signals and connect them to a better indicating system of your own design.

Drive to the resolver comes from integrated circuit U2, an 8-pin DIP visible to the left of the resolver in **Photo C**. Pin 1 is the sine (east-west) signal and pin 7 is the cosine (north-south) signal. Maximum-to-minimum swing of each signal is about 4.8 volts.

U2 stages are voltage doublers as well as drivers. The output voltage range of U2 is too great for some applications, including the NorthScope to be described next month. More suitable tapoff points are at the outputs of U1, the stages that feed the 2x drivers. U1 is the 14-pin IC above and to the right of the resolver in **Photo C**. Pin 1 of U1 is the sine integrator output and pin 7 is the cosine integrator output. **Table 1** shows the approximate U1 output voltages for 16 compass headings. Note that the signals swing positive and negative with respect to a +4.2-volt analog reference level, which is one half of the +8.4-volt regulated supply line.

Photo E shows how I obtained the analog signals for my external display. U1 outputs are hidden under the resolver disc, so I tapped the sine output at the lower pad of R9 and the cosine output at the lower pad of R19. The analog reference voltage and circuit return are also required by the display; they may be tapped at the positive and negative terminals, respectively, of C13. This 100-microfarad electrolytic capacitor is next to U5 on the bottom of the horizontal circuit board, not visible in the photo.

A fluxgate sensor on your mobile beam's mast is an excellent aid to transmitter hunting on wandering roads. Next month's Homing In will have the details of an easy way to put the sin/cos outputs to work in a two-dimensional cathode-ray-tube (CRT) display

Continued

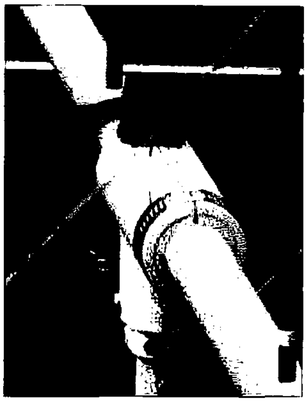


Photo D. I attached the sensor module to the top of the Cubex quad boom. Before mounting, I marked a line at exactly +15 degrees from the boom axis. I then aligned the sensor with the line to compensate for magnetic declination.

Degrees	Direction	Sin Out	Cos Out
0	N	4.2	5.4
22.5	NNE	4.7	5.3
45	NE	5.0	5.0
67.5	ENE	5.3	4.7
90	E	5.4	4.2
112.5	ESE	5.3	3.7
135	SE	5.0	3.4
157.5	SSE	4.7	3.1
180	S	4.2	3.0
202.5	SSW	3.7	3.1
225	SW	3.4	3.4
247.5	WSW	3.1	3.7
270	W	3.0	4.2
292.5	WNW	3.1	4.7
315	NW	3.4	5.0
337.5	NNW	3.7	5.3

Table 1. Approximate voltages with respect to ground at the sine and cosine tapoffs from the DCS 800 before the 2x resolver driver stages.

QRP

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Last month, we talked about rechargeable batteries. Lead-acid and NiCd are by far the most common types you'll encounter. However, in the next few years you'll be hearing more and more about the nickel metal hydride, or Ni-MH, and the lithium ion batteries. Let's take a look at them this month.

The Ni-MH battery

The nickel metal hydride battery is a close relative of the NiCd. It has a very similar discharge curve and has the same 1.2V per cell state of charge.

The Ni-MH battery has a specific energy that's about twice as good as a lead-acid battery. It also has a specific power density that's on par with the lead-acid battery. Ni-MH batteries also have great cold-weather performance, but they don't do as well as the lead-acid batteries at higher temperatures—so you could see lower than expected results from a Ni-MH battery if your Field Day occurs in a very hot location.

Also, don't be misled by some of the ads you see. Nickel metal hydride batteries *do* in fact suffer from the dreaded memory effect. However, it is not as pronounced as with the NiCd cell.

The Ni-MH battery has a lot going for it, and since no hazardous materials are used, it can be safely disposed of at the end of its life.

A point to mention before you drop a lot of money on new metal hydride batteries: Most of the old NiCd chargers won't like the new cells. If you change over to metal hydride, you'd better plan to spend money on a new charger, too.

You could easily home-brew one of these special chargers using the chip sets provided by Maxim™ as well as others. At one and two chips at a pop, they are a bit expensive—but a project like this would be a great one for a club.

Lithium ion batteries

You may have heard a lot about these guys. They are now popping up in laptop computers, at a premium price. Their energy density is much greater than the NiCd or the Ni-MH battery, and they have almost five times the energy density of a lead-acid battery. The lithium ion battery has a lot going for it, but there are a bundle of problems with these cells.

First, they're *expensive*. It's quite easy to get up to ten times the price of a battery pack if you choose lithium ion cells—and they're very picky about how they are recharged. You must use a special charger built *just* for these cells. Also, right now, they come in limited cell sizes. You won't find large-capacity cells on the market (that you can afford) just yet. As production increases, you'll see more sizes and lower prices.

Charging these special use batteries

While we can get by with a basic cheap-and-dirty charge scheme to fill up the lead-acid batteries, the Ni-MH and lithium ion require a bit more brains. Luckily for us, there are several companies that make special purpose ICs to do just that!

Primary cells

Although we've been talking about rechargeable cells, don't overlook the primary or one-time use cells. There's a lot of bang for the buck hiding inside an alkaline battery! Do you remember the old Icom™ IC-2AT handheld? For a few bucks, you could get the battery pack that would hold AA-sized alkaline batteries. You could talk and talk on the same set of batteries while the other guy went through three NiCd packs. Best of all, you could buzz into the local stop-'n'-rob on the way to the hamfest for a pack of batteries for under five bucks. Of course, once they were used up, you threw them out. And all those replacement batteries do add up, both on your budget and in the landfill.

RENEWAL® batteries

Thanks to Ray-O-Vac™ and their RENEWAL cells, you can get the power of the throwaway batteries with the ability to recharge them over and over. I've been using the RENEWAL cells in several sets of consumer equipment and have had very good results. Here are some hints you may want to try if you plan to use the RENEWAL batteries in your QRP equipment.

First, they really like to be recharged. Don't wait till they're dead before sending them to the recharger. Charge often and they'll last longer.

They appear to like loads that consume current. They love CD players and tape players. They don't care too much for low-current loads like radios (the old AM/FM types).

You must use the charger designed for the batteries. A NiCd charger will destroy the cells in a short time. See the March 1997 issue of *73* magazine for a build-it-yourself charger for these cells.

Next month, some antenna tuners and various antennas! 73

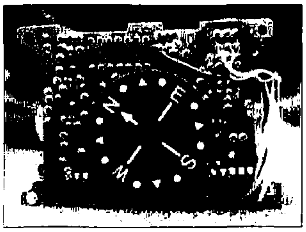


Photo E. Front view of the vertical display board with the face plate removed. Wires have been added to pick up the sine and cosine signals, as well as the analog return and DC ground.

HOMING IN *continued*

of bearings relative to true north. The NorthScope is all analog—no software or digital circuits are required. Meanwhile, keep the letters and E-mails coming with your RDF projects and news of T-hunting activities in your area. For more information on RDF equipment and links to T-hunters in your area, surf over to the Homing In Web site listed at the top of this article. Don't forget the forward slash at the end. 73

Continued from page 7

available at hamfests for as little as $50, and they will do the job. A well-written DOS program will run perfectly on any Intel processor from an 8088 through today's fastest Pentiums—and in contrast, way too many Windows 95 programs run poorly on the single platform that supports them. DOS programs also tend to be very portable for the most part. A lot of my ham-related programs will run from a single disk. I also use the HP 200LX Palmtop for field ops and mobile packet with some very smartly designed DOS programs since their memory footprint is extremely low, using less than the 640k base, which is a standard part of any PC. Many of my all-time favorite programs are older shareware, freeware, and public domain DOS programs. They were designed by users for users and usually worked first time around. Features were added as necessary and the revision and upgrade numbers actually had meaning. The author actually conducted the debugging and beta testing, not the consumer out of his own pocket.

3. The Common User Interface is Microsoft's attempt to force us all to work the same way. It's great for the three "bread and butter" applications, namely word-processing, spreadsheets, and databases, but is irrelevant and a very uncomfortable fit for other kinds of software. Tell me, for example, how do the basic "File, Edit, View, and Insert" commands relate to a Morse training program or a rig interface program?

4. Windows 95 development is obviously not the bed of roses Mr. Carr claims. In almost every instance I can think of, the "new" Windows 95 versions of programs load and run substantially slower than their DOS antecedents. Maybe Visual Basic 5 does indeed approach the speed of Visual C, but that's just a way of saying how bad performance in Visual Basic has been since version 1.0. A Turbo C program on a 386 will beat the pants off either of them. How many of you remember the speed of Turbo Pascal on the 286 machines?

5. One of my biggest pet peeves is forced consumerism and the underlying implication that we are worthless as human beings unless we run right out and buy the "best, fastest, newest" products. Companies seem to be intent on rushing poorly designed and poorly tested products into the marketplace in a seemingly overzealous attempt to garner sales and grab the big bucks, not to mention the advertising push with a fair amount of trashing of other peoples' products. The poor consumer is forced to debug these products out of his or her own pocket, or have you noticed that Iomega charges nearly $15 for a tech support call and many others have instituted the pay-per-problem premise? Apparently, after surviving sufficient levels of frustration, complaints and jammed phone lines the consumer is made aware of a new soon-to-be-released version of the product; and, of course, the consumer is expected to pay for this version as well if he/she desires to have all his woes settled and have a program that actually works. More often than not, the new version costs more than the faulty one and basically all you are paying for is a patched version of the old program. So, where do we draw the line and stop buying into this marketing insanity? All in all, there are many "excuses" for offering MS-DOS software, and will be for several years. There are very many good and desirable DOS-based programs still on the market and still available through various BBS or Internet sites. One of the neatest things about DOS programs is that there are no GPF messages and the "you know you're gonna die" Close/Ignore buttons. Also, the memory reserves aren't occupied with all the graphic refresh rates! What is inexcusable is the way we have let Microsoft take control of the entire personal computing industry. And the way some of us appear to have swallowed Microsoft's propaganda.

As a known Mac user, both DOS and Windows are beneath my contempt. Hey, Carr, shame on you for getting us involved in a theological argument. Leave that mischief to me ... Wayne.

Continued on page 70

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

Satellites have been used for decades to send television signals across the continent and around the world. Today there are hundreds of channels of programming available from commercial geostationary-orbit satellites. With dishes as small as 18 inches, homes from urban to ultra-remote locations can have enormous viewing options; many amateur radio operators have often wondered why there are no hamsats for TV.

Full-motion, real-time, analog television is a very difficult mode. For terrestrial ATV (amateur television) enthusiasts, high power, big antennas, quality coaxial cable, low-noise preamps and wide bandwidth are required to work TV. ATV repeaters help dramatically, the same way FM voice repeaters allow fringe and low-power stations to communicate across large distances.

A repeater in orbit would be great, but there are a few problems. The bandwidth for earth-to-space or space-to-earth ATV is not available in the VHF and UHF regions; thus the lowest frequencies available for use would be the 1260–1270MHz satellite uplink band and the 2.4GHz satellite downlink range. Another problem is convincing the satellite builders that an OSCAT (Orbiting Satellite Carrying Amateur Television) would be a good idea. Most of the technical wizards who design and build the hamsats agree that full-motion TV is possible, but describe solutions that are digital in nature and require special modems and video compression methods. This would need special gear for the earthbound user, but would allow the "video" to be sent in a narrower bandwidth. Good quality analog FM ATV would require at least 10MHz, while digital compression modes could take less than 1MHz for similar results.

SSTV from orbit

Only 10 days after the launch of AMSAT-OSCAR-6 in October 1972, Don Miller W9NTP wrote a letter to the editor of the *AMSAT Newsletter* describing his efforts with WA9UHV to send SSTV (slow-scan television) images via the new satellite.

In his letter Don described systems that included equipment that might be found in a ham radio museum today, but 25 years ago represented state-of-the-art gear. HF transmitters with transverters and home-brew video samplers and modulators provided uplink signals while more home-brew equipment was used to view the black-and-white images sent through the Mode "A" (2m up and 10m down) transponder. These pioneering efforts have provided inspiration for today's video experiments and some exceptional possibilities for the future.

In his mid-seventies book, *OSCAR Amateur Radio Satellites*, Stratis Caramanolis recounted efforts by DL8AT and OE3KMA to send SSTV pictures via the Mode "B" (70cm up and 2m down) transponder on AMSAT-OSCAR-7. The year was 1976 and eight-second, black-and-white pictures were still the standard. These efforts led to additional image transfer techniques including facsimile (FAX) transmissions by DLØVB and others.

Digital pictures

During the 1980s, emphasis was placed on the purely digital modes like AX.25 packet. Today we have several digital-only satellites in orbit capable of providing worldwide store-and-forward services. Sending image files of all types via these electronic bulletin boards in the sky has become common. Moving pictures like .MOV, .AVI and animated .GIF files have also been uploaded to the 9600-baud digi-sats. SSTV real-time image exchange via satellite has declined, but thanks to advances in inexpensive digital interface techniques and individual efforts, SSTV operation gained some popularity while AMSAT-OSCAR-13 was in orbit. Dave WB6LLO hosted an SSTV net on the satellite on a regular basis.

With sufficient data transmission speed (requiring wider bandwidth), experiments with compressed and digitized video will be possible through Phase 3D.

SAREX, SSTV and ATV

Dr. Tony England WØORE took the Shuttle Amateur Radio Experiment (SAREX) equipment into orbit on the shuttle *Challenger* in August 1985. Part of the ham gear included a modified ROBOT 1200C scan converter for SSTV. The image-control software on the shuttle supplied automatic sequencing, providing two red-filtered frames (eight sec.), one green, one blue, a low-resolution color frame (12 sec.), and a high-resolution color image (36 sec.). Many stations monitored the signals using home-brew SSTV systems or new and expensive ROBOT equipment. Others simply recorded the warbling tones in hopes of someday decoding the cryptic sounds and viewing the pictures. Further experiments with SSTV from the shuttle continued on missions STS-37, STS-50 and STS-56.

In addition to sending pictures earthward, the shuttle apparatus can also receive and display images sent from earthbound hams. During Tony England's flight, a picture of the astronauts' wives was sent up to space and displayed on one of the monitors located in the aft crew station. The picture was stored and sent back to Earth a few minutes later. During STS-50, schools with suitable SSTV gear sent pictures of the students up to Dick Richards KB5SIW and the other ham crew members on board the *Columbia*.

There are advantages and disadvantages to shuttle-based SSTV operation. On the plus side, the signals are sent via two-meter FM transceivers. Signals are strong and color errors caused by frequency shift experienced using SSB is not a problem. The greatest disadvantage is the length of time available for picture exchange. Shuttle passes are usually very short, 10-15 minutes. The ROBOT equipment is capable of a 72-second mode, but images are usually sent in the 36-second mode to allow the exchange of as many pictures as possible. The ROBOT gear is also limited to those ROBOT modes hard-coded in the scan converter. More SSTV activity is expected for future SAREX flights.

Later FSTV (fast-scan TV) experiments to uplink standard 70cm ATV video to the Space Shuttle required FCC permission for participating stations to send 6MHz-wide signals to space. The 70cm satellite uplink band is normally only 3MHz wide. While the experiment worked for the few stations with high-gain antenna systems, high power and the FCC waiver, the activity will probably not be repeated. A move to higher frequencies and something better than the inside-the-window antenna will be needed to allow general ham involvement.

Mir and ATV

While the principal ham activities of the *Mir* crew are via FM voice or packet, there is also the SAFEX (Space AmateurFunk Experiment) repeater system. It was developed in Germany and then sent to the *Mir* space station. The primary unit is a 70cm in-band FM voice repeater, but the second radio unit (for later installation) includes a crossband linear transponder with a 1265MHz input and a 2410MHz output. While use of the 70cm voice system is geared more toward "normal" ham operation, the L/S-band (1.2GHz/2.4GHz) system is an experiment designed to test techniques that may become more prevalent on future manned missions. The microwave transponder is 10MHz wide using an IF (Intermediate Frequency) in the 70cm band. This bandwidth is capable of passing high-speed data or even television signals. The ATV group at the University of Bremen was tasked with the design and construction of many of the L/S-band components. The wide bandwidth of the transponder is sufficient to pass most AM or FM ham TV signals.

Number 57 on your Feedback card

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119
E-mail: [clhough@pacbell.net]

More on making silk-screened PC boards

I hope I gave you some insight last month on making PC boards such as the 3-band feed. Maybe this has whetted your appetite for more home PC board construction. This month, I want to give you more detail about the materials and methods used.

Alternatives

First, let's go over some alternatives to home PC board construction. Number one would be to go to a commercial board fabrication house. I have been told that charges for such a venture can go into the hundreds of dollars for the first run of a dozen PC boards or so. This is so that the production house can recover their initial setup costs. Board production runs after this initial setup can run in the under-$10-per-board cost range, depending on board complexity.

An alternative more in the amateur radio scheme of things, yet still using a commercial operation, is to use FAR Circuits. FAR specializes in amateur radio projects and has been providing PC boards for projects published in many amateur radio magazines. They also will do custom work at very reasonable prices. If you want to take this route and have artwork ready for board production, contact FAR for a quote. Their address is FAR Circuits, 18 N 640 Field Ct., Dundee IL 60118. Send an SASE or call (847) 836-9148 for voice mail or FAX communications.

If you are on E-mail, FAR Circuits can be contacted at [farcir@ais.net]. They also have a home page at [http://www.cl.ais.net/farcir/] for board listings and details. They are very reasonable and offer a quality product that you might want to take advantage of for amateur-only board production.

Make your own

What are the benefits of making your own PC boards? I started to make PCBs back in the late 1960s when I was quite involved in traffic handling using teletype machines (RTTY) for the Navy MARS (Military Affiliated Radio Service) program. In this effort, I was assisting in running a small parts bank distributing surplus component parts to Navy MARS members in the five western states as part of the 11th Naval District MARS program.

In this Navy MARS endeavor, I wanted to find an inexpensive method of producing PC boards to distribute for free with kits of component parts for AFSK (audio frequency shift keyers) and for RTTY converters. The push to RTTY operation meant a vast improvement in message handling when stations were teletype capable.

Getting started

Since the boards were provided for free and we did not have deep pockets, an economical method had to be found to produce them. This assumed that we had a negative of a board ready to start the silk-screen process. The negative was then transferred photographically to the screen material on the silk-screen frame.

There are several methods you can use to make a negative for silk-screen processes. The negative that is produced can be used not only for silk-screening, but also for many other methods as well.

The highest-quality result from a detail in copper on the PCB comes from the photoresist method. I had to pass over this method, though, as the setup cost was a little too high for the initial investment in material. When I looked at this method, the spray-on photosensitive resist and pre-sensitized PCB materials were too expensive or not of high enough quality for me to be interested in them.

Pre-sensitized PCB stock was a major cost, with boards priced at $10 for a small 4- x 6-inch one. Our efforts to hold down costs readily sold me on silk-screen printing.

Materials

Materials needed for silk-screen printing include:

• A few wooden frames to hold the screen mesh. I constructed frames 12 inches by 18 inches out of 2-inch-square frame stock (cut from 2x4s).

• Silk-screen mesh at $8.50 a yard.

• Nasdar™ Circuit Black #211 ink, $11.75 a quart.

• A quantity of paint thinner and lacquer thinner.

• Several rolls of paper towels (plain white).

• UV-light-sensitive contact silk-screen film, manufactured by Ulano Corp., 225 Butler St., Brooklyn NY 11217. My cost was about $50 for a roll of film 40 by 150 inches long, which should be a lifetime supply.

• Hydrogen peroxide, from any grocery or drugstore.

• Wooden work block (see below).

• Block Out™ water-soluble glue.

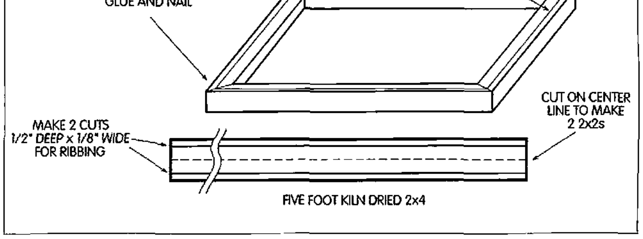


Fig. 1. The bottom of the silk-screen frame construction, showing the wooden frame groove and rubber ribbing that will hold the fine-mesh screen material in a firm, taut position. The cloth is stapled on the outer edge and then taped over to prevent fraying and loose threads dangling. Frame is constructed from kiln-dried 2x4 stock cut into 2x2 pieces.

Hamsats *continued*

At 2410MHz, a signal can exhibit over 100kHz of apparent drift from AOS (Acquisition of Signal) to LOS (Loss of Signal) during an overhead pass. While SSB (Single SideBand) or CW (Continuous Wave) operation through the transponder will be a significant challenge, the wideband nature of TV will not. Automatic Frequency Control (AFC) circuits can deal with the tremendous frequency shift, allowing the receiver to lock in and hold the signal after initial tuning.

Why not OSCAT?

If the results of the *Mir* L/S-band transponder are promising, interest in producing a dedicated OSCAT may take hold. Most hams collect high-tech electronic devices, including camcorders, VCRs, and other video-related devices. An orbiting satellite capable of receiving and retransmitting ATV signals may be just the thing to spark the interest of many hams who have not even considered hamsat operation. It will certainly be a new challenge for dedicated satellite chasers. A microsat-type unit with receivers for command and 1.2GHz video input, coupled with a transmitter for 2.4GHz video downlink, can be the starting point for the program. AMSAT (The Radio Amateur Satellite Corporation) has already developed the spaceframe for this type of hamsat including batteries, solar panels, control systems and antenna placement. Single-channel FM satellites work—why not television? 73

• Rubber ribbing used for aluminum screen-door repair.
• Good-quality, heavy-duty, waterproof masking tape.
• Rubber squeegee.

The process

You start by contact-exposing the film to your negative in bright sunlight or high intensity UV light. I use bright sunlight of one-minute duration. The film can be handled in normal room light for several minutes with no ill effects.

Mix two parts water to each part hydrogen peroxide and develop the film for one to two minutes.

Now the critical step. Have a mildly aerated supply of lukewarm tap water running before removing the film from the developer. A small, scrap PCB can be used as a flat plate to put the film on under the running warm water.

Make sure that the film is always covered in water while you rinse it. After a short while, you will see contrast between the film removed and what remains on the vellum backing of the film, showing you the pattern to be transferred to the silk-screen frame mesh.

Prior to starting the film washing, you want to make sure you have a wooden work block of a size larger than the entire film being developed. After rinsing, the film is laid on top of this block. In the meantime, the screen is at the ready, its mesh being slightly moistened with warm tap water. Now the critical point: The film being rinsed is ready to attach to the frame when the pattern is clear enough where appropriate to pass ink through yet still the color of the original film (red) in protected areas.

At this time, remove the film quickly and place it face up on the wooden block. Place the silk-screen frame on top of the film and block. The frame's wooden edge dangles in midair around the block of wood, forcing contact of the screen mesh into the soft red transfer film and embedding the red film into the threads of the frame's screen mesh.

Assist the drying of the pattern by placing a paper towel on it and pressing gently to assist in embedding the film into the threads. A very easy touch is required here, as a hard one will distort the original pattern and cause it to mushroom out of shape. When the transfer film is dry, the Mylar™ backing is removed. It should come off easily. If there is any resistance to peeling this backing off, let the film dry for a another half hour or so.

When the backing is peeled off, a water-soluble glue called Block Out is placed on the screen frame on the outer edges of the transfer film. Be careful not to get any on the transfer film pattern. It goes on the edge of the film because this forms the final barrier to ink passing through other parts of the screen that are not protected by the transfer film. Only the parts to be printed on the copper PCB show through the screen without obstruction.

Frame construction

The cost for kiln-dried 2x4 wood to make wooden 2x2 frame members to hold the silk-screen (really nylon) material is quite low. The other related frame materials needed are the rubber screen-door repair ribbing used in aluminum screen-door replacement and a good-quality, heavy-duty masking tape. The cost of these items is minimal.

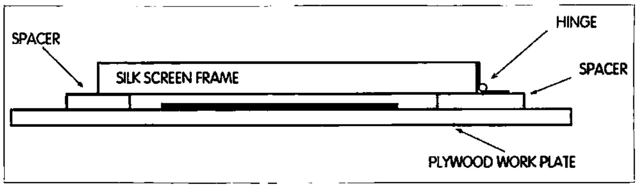


Fig. 3. Side view of silk-screen frame shows hinge to lift frame for board insertion and spacer to allow a small space between bottom of screen material and top of PC board. This ensures that contact with the PC board will be only at the edge of the squeegee as it is pulled along the length of the PC board pattern on the silk-screen frame.

Have the 2x4 material precut into easy lengths to work with, say, five feet long. Cut a groove into the front face about half an inch from each edge. This groove is wide enough to be a tight fit for the rubber screen door ribbing when it is pushed into the groove. You don't want this to be very tight—just sufficient to hold the screen taut when stretched and held in place with the rubber ribbing.

The screen

The groove width is usually about 1/8-inch wide. See **Fig. 1** for the groove and the method of using the rubber ribbing to hold the nylon screen material to the wooden frame. The rubber ribbing is pushed down into the groove to tighten the screen material quite taut, but it's not so tight as to rip the nylon fine-mesh screen cloth.

When the material is tight, it will show signs of stretching when the middle is pushed with your finger. We just do *not* want to see any wrinkles in the material. When the screen is taut, staple along the outside edge of the cloth screen material to the outer wood strip on the wooden frame outer edge. Any excess cloth on the outside of the frame may be cut away. After excess cloth is removed, a paper tape or good-quality cloth waterproof tape can be used to hold the cloth edge to the wood frame end to prevent fraying and anything from catching the cloth on the surface of the frame. This surface is the bottom of the finished frame.

Turning the frame over, a similar smaller-width piece of tape is placed on the inside edge of the cloth mesh, with the outer edge on the inside of the box bottom. This tape will prevent the inks and solvents used in the silk-screen process from working their way under the tape and cloth at the edge of the inside of the frame. See **Fig. 2** for a look at the inside view of the frame. **Fig. 3** shows a side view depicting the hinge at the rear of the frame, which allows the frame to swing up for removal of the old blank or placement of a new one beneath the frame.

Ink time

Nasdar #211 Circuit Black ink is then placed in contact with the upper screen. It will not flow through the fine mesh unless the squeegee draws it and pushes it across the pattern. If you want, you can place a piece of paper on top of your circuit board prior to actually printing on copper. This makes a test print to see how well you can transfer (print) the inks onto the paper and what level of detail you have been able to retain.

Scrounging

Well, there's a preliminary run-through of the major steps of PC board silk-screening from an inexpensive point of view. Oh, yes: Where can you look for PCB material, particularly at low cost?

For amateur scroungers, the best way is to locate a PC board fabrication house somewhere in your area and try to purchase scrap pieces of copper board. They usually have large quantities of

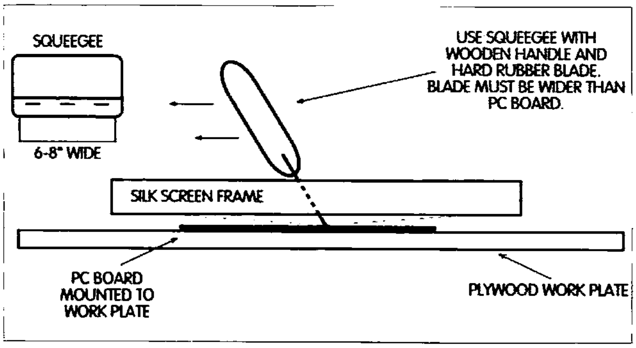


Fig. 2. Front view of silk-screen printing shows rubber squeegee pulled over the pattern on the screen material to draw ink along inner frame over the pattern for deposit onto the PC board.

Number 59 on your Feedback card

Ham to Ham

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
E-mail: [dmiller14@juno.com]

Please keep your ideas, tips, suggestions and shortcuts coming my way, either by "actual mail" or cyber-mail. "Ham to Ham" is a reflection of your interests and input, and its content is only as good as the support that I receive from you, the reader. So send your tips to either of the addresses shown above and there's a very good chance that they'll appear in one of the future columns.

They're not just for PCs anymore!

With the current widespread use of multimedia PCs (personal computers), the availability of some pretty nice-sounding multimedia speaker/amplifier units also exists. These speaker/amplifier units are often available at hamfests, computerfests, or discount outlets at very attractive prices, and we hams might well consider their use in other areas of our hobby—they're not just for use as multimedia PC sound drivers anymore!

PC speaker/amps can, for instance, be used in a noisy mobile environment to augment the sometimes difficult-to-hear audio from an amateur-band hand-held portable transceiver or a portable scanner receiver. They can also be used within the home station to boost the audio from an amateur receiver, transceiver, DSP unit, or other audio source that might need just a bit of extra oomph.

Many of these PC speaker/amplifiers will operate quite satisfactorily from their own internal battery power, but if you'd like to supply longer-term DC power from the 12VDC cigar-lighter outlet in your car, or a small 120VAC-to-low-voltage-DC adapter in your home shack, then you may need to consider building a little circuit something like the one shown in **Fig. 1**.

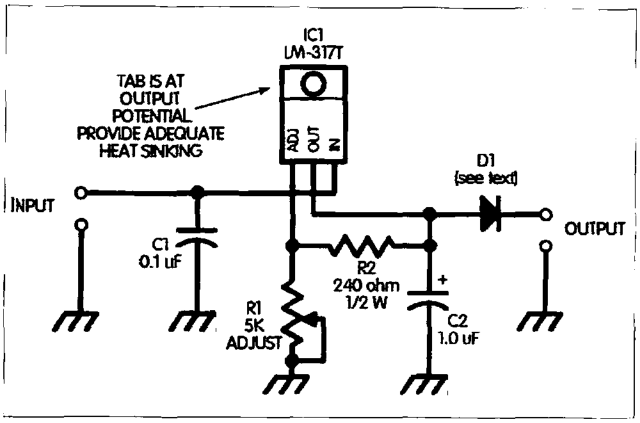


*Fig. 1. Basic variable regulator circuit using an LM-317T regulator IC. Adequate heat sinking must be provided for the LM-317T depending on the voltage and current to be handled by the device. Tab is at output potential. *D1 is needed only if there exists the possibility of back-feeding a voltage higher than the output voltage. There will be an additional 0.7V drop across diode D1.*

The schematic diagram of **Fig. 1** shows an adjustable low voltage regulator that can be easily constructed on a small piece of perfboard, or even by directly wiring to the terminals of the regulator chip itself. It utilizes an easily obtained LM-317T regulator in a TO-220-style case (available from several of *73*'s advertisers), which will handle an amp and a half of output current (when properly heat-sinked), and up to 32VDC input voltage (the input must be DC, not AC). It then regulates that higher-voltage DC down to 3V, 6V, 9V, or 12V (or anything in between) for powering your PC speaker/amplifier.

Note (in **Fig. 1**) that you may elect to make the regulator circuit either variable (by the use of a 5k pot for R1) or fixed (by choosing a suitable fixed resistor for R1 from **Table 1**). If you don't intend to ever change the voltage, the fixed resistor option is the best choice because it will never change by itself (such as might happen were the pot to become "noisy"), and it's a bit less expensive to build it with a fixed resistor than it is with a variable potentiometer.

Whatever source of power you end up using, it should be reasonably well-filtered (so that audible hum isn't a problem), and it should, of course, be able to supply the current needed by the speaker/amp with some overhead margin for safety. It must also be of positive polarity. Other than those precautions, you should find the circuit pretty much universal in its application. You might also find that you can run

Fixed Resistor Values for R1

130Ω	2V output
310Ω	3V
490Ω	4V
660Ω	5V
840Ω	6V
1,020Ω	7V
1,200Ω	8V
1,370Ω	9V
1,550Ω	10V
1,730Ω	11V
1,900Ω	12V
2,070Ω	13V
2,250Ω	14V
2,430Ω	15V
2,600Ω	16V
3,000Ω	17V

***Table 1.** Approximate fixed resistor values for R1 in **Fig. 1** if the variable option is not needed.*

miscellaneous sizes or end cutoffs that are lying around, doing no one any good. Offer to pay double scrap value, and ask for a break because you are looking for PCB material just to make homemade boards for your amateur radio hobby.

Let the PC board house know this is not a commercial venture. And if you are allowed the courtesy of digging in their scrap bin, use leather gloves so you don't get cut, and leave the area cleaner than when you found it. This will give you the best shot at permission to scavenge again.

The small circuit board material that I usually find is in 12- by 12-inch pieces and smaller, usually with some small predrilled holes in a corner from an error in production. The scrap bin is usually filled with sizes suitable for amateur circuit boards—and then some. To locate these shops, look in the Yellow Pages™ under Printed Circuits, Silk-Screen Printing, or Wholesale Suppliers.

That's it for silk-screen methods for now. Next month, I want to get into a good shakedown test you should make before you use your portable microwave transceivers. What we will both go through is the pre-test in the shack prior to portable operation in August's ARRL 10GHz Contest. Hope to see you on 10GHz soon. Please note my new E-mail address at the top of the column, as I have shut down the AOL operation. 73, Chuck WB6IGP.

Editor's note: No mention of homemade PC boards would be complete without pointing out Kepro Circuit Systems, Inc., 630 Axminister Dr., Fenton MO 63026-2992; tel. (800) 325-3878 [in St. Louis, (314) 343-1630]; FAX (314) 343-0668. They offer a wide variety of products and kits, as well as a free catalog and free "how-to" booklet. Also, The Meadowlake Corp., P.O. Box 1555, Oneco FL 34264, offers a specialized iron-on film for PCB do-it-yourselfers. Write for further information.

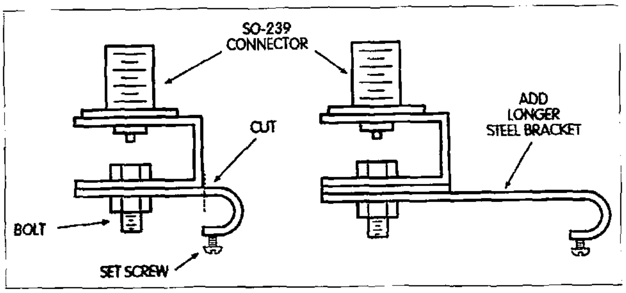


Fig. 2. The original and modified trunklip mounts described in text by AD5X.

two or more speaker/amps off one regulator module—again, depending upon how much current is drawn by each. Just be sure to stay safely under the 1.5A maximum limit of the LM-317T and ensure that the chip is provided with enough heat dissipation mass so that it won't go into thermal shutdown (a condition wherein the chip shuts itself off due to too much heat buildup internally). The heat sink mentioned can be a piece of scrap aluminum or one of the black-colored, finned heat sinks sold specifically to fit TO-220-style chips. Silicone grease should be used between the chip's tab and the heat sink mass for the best possible heat transfer characteristics (and to prevent "hot spots" on the chip's case).

With the LM-317T, just be careful not to allow the heat sink tab (or anything connected to it) to come into electrical contact with common ground. The tab on the LM-317T is at output potential electrically, so it must be isolated from the circuit common connection (negative DC lead).

The regulator chip has some built-in safety modes—protection against overheating (as mentioned) and short circuits (should the output circuit be accidentally shorted). One thing that these regulators won't tolerate is back-feeding a higher voltage into their output lead. This could happen if a battery pack of higher voltage is connected to the chip's output (without a blocking diode to prevent feeding the voltage back into the regulator) or if you accidentally connect the regulated bus across another higher voltage circuit bus. I've seen regulator chips literally explode with a bang (and in many flying pieces) under these conditions! Diode D1 on the schematic provides the necessary protection.

With proper use, however, it isn't difficult at all to incorporate an LM-317T into a universal regulator for powering almost any small accessory, including those bargain PC speaker/amps that often surface these days.—**de Dave NZ9E.**

Nearly FREE parts!

From George Primavera WA2RCB: "I recently encountered a failure of the external speaker jack on my Icom general coverage receiver. The jack was an 'Alps' (manufacturer's name) component, designed for mounting directly onto the PC board. The small cubical plastic shell which serves to hold the metal contacts of the jack assembly together had cracked across the top, rendering the little jack useless. Knowing that such a part was not the type normally available from convenience electronics outlets like Radio Shack™, I searched through the electronics mail-order catalogs. Unfortunately, the problem with mail-order parts, at times, is that if you don't have the exact part number and/or the technical specifications of the part you need, you might not get a suitable replacement. Then I happened to look at a couple of old VCRs that I had salvaged from a nearby TV/VCR repair shop.

"Most people now throw away their old VCRs rather than fix them, and I had a few of these 'throw-aways' on hand for their spare parts value. A TV/VCR repair shop in my town was more than happy to clear their shelves of a couple of these lifeless samples just for the taking. Guess what? The external audio jack attached to one of the scrap VCR boards was an exact replacement part for the one needed for my Icom! It was even made by the same manufacturer, Alps Electric Ltd.! Looking at the VCR board, it then became apparent that many of the same passive components (capacitors, resistors, jacks, push buttons, etc.) were identical to those used in my Icom. When you think about it, it makes sense; why use different production-line components for ham radio equipment and those that are used in Japanese consumer goods like VCRs, TVs, cellular telephones and the like? While there are certainly some components—namely higher-power RF parts—that won't show up in consumer electronics, many others do. Some just might be waiting for you to use, and for significantly less than the parts and labor costs you would have to pay if you didn't do the work yourself!

"One final example: My Yaesu FT-23R developed an intermittent PTT switch recently. I happily found an exact replacement for the Yaesu's switch behind the front panel of a scrapped Canon VCR I had picked up, free, at the local TV shop. The HT now works just fine, and the cost of replacement parts was about as reasonable as it gets! So next time you need a part, you might consider looking at scrapped consumer electronics items. Of course, it's always a good idea to pre-test the salvaged component before installing it in your ham equipment. Some of the newer VCRs also make use of many surface mount components, and these are a ready source for chip diodes, resistors and capacitors which are often needed for modifications to the newer, smaller ham gear. Look into these 'gold mines' and you might just save yourself a few hard-earned dollars (and not have to wait for the postman) the next time your ham rig develops a easily correctable fault."

Moderator's note: A man after my own heart! Thanks for the suggestion, George. You'll often find scrap VCRs, etc., at hamfests these days as well. They're usually just a couple of dollars, or even free, if you just stick around 'til closing time. Many vendors would prefer not to lug the "no sale" items back home again.

Slippery characters

From Richmond B. Shreve, Jr. W2EMU: "The shiny little plastic trackball pointing device used on many laptops can develop a tendency to slip due to dust, skin oils, or (often) from snacks we tend to keep close by while using our computers! I've found that adding some measure of texture to the surface of the trackball, however, can help to reduce this slippage problem quite a bit.

"Here's one procedure: First, round up a small (4" x 6") square of very fine sand paper. I used 220 grit, but a finer grit might be even better. Form the sandpaper into a tube slightly larger than the ball itself, with the gritty side on the inside. Remove the ball from the computer's trackball housing and place it inside the tube with your fingers over the ends. Now, shake... the tube, that is! As the ball travels back and forth inside the tube, all surfaces should become approximately uniformly roughened. It took about three minutes of shaking for a satisfactory result when I tried it.

"This procedure leaves the ball rough and gritty, but we're not done quite yet. To change this to a smooth but textured surface, place a small amount of toothpaste in the palm of your hand and 'massage' the trackball with it, taking care to rotate the ball so that all areas are equally burnished. Most toothpastes have a slightly abrasive component that helps to clean tooth surfaces. It will do the same for the plastic trackball.

"Now, after thoroughly rinsing and drying the ball, set it aside for a few minutes while you clean the socket. I found that regular drugstore eyeglass cleaner on a cotton handkerchief works well for this. Also, clean the little rubber wheels that the ball rides on in the trackball housing itself... the little wheels that generate the vertical and horizontal movement of the cursor. Blow away any residual lint from inside the housing and reinstall the ball and its retaining ring.

"The ball action may have a somewhat gritty feel now, but it will be far less easily affected by the oils and dirt that could have led to slippage in the future."

Oops!

From Bill Turner W7TI: "Oops, there goes a cup of coffee right across the front of your new

ham transceiver! It's a good thing that it wasn't turned on, though you still have the unpleasant job of cleaning it up—but what's the best method?

"Believe it or not, water (and a little mild detergent, if necessary) can often be the most effective method. Where I work, we wash PC boards each day, using a special detergent made for that purpose, as part of our routine cleaning procedures, and it works just fine. The key is to make sure that everything is thoroughly dried afterward, as quickly and safely as possible. We dry the washed boards in a 170°F oven for 30 to 45 minutes.

"Depending on where you live and the amount of minerals in your local water, you can probably get away with using ordinary tap water for the bulk of the cleaning, but always use distilled or deionized water for the final rinse. Distilled water is readily available in most supermarkets these days... Perrier™ water isn't necessary. HI!"

Moderator's note: Bill's methods can be the simplest and most effective way to handle this "sticky" problem! I've used similar procedures on really grimy items of electronic gear, but you have to be careful. Complete removal of easily damaged parts may be the safest approach. But if you decide not to remove them, keep all water away from transformers, relays, and delicate meter movements. I saw one of my power transformers go up in smoke, even after what I felt was a thorough drying, baking, and appropriate idle time. It was a high-voltage transformer for a monitor scope, and even the slightest dampness in the insulating layers of the transformer were enough to cause its demise. If you want to skip the oven-baking step, the drying process can be accelerated by using an ordinary hair dryer for a short period and/or a muffin fan left blowing on the chassis overnight. If you do use dry heat, watch for dark colored parts (black plastic panels for instance) becoming too hot, too quickly.

More backlip

From Phil Salas AD5X: this "happy mobiling" suggestion for hatchback owners: "So far, I've not been able to find anyone who makes a 'true' hatchback vehicle antenna mount. Though you can use something like the Comet RS-21 hatchback/trunklip mount on the side of the hatchback, you can't use it on the top lip of the hatchback door. The lip of the hatchback drops down below the vehicle's roof level, causing these types of mounts to hit the vehicle's roof before the hatchback door is fully open; at least this is the case with the Chevrolet Geo, the Toyota Tercel, and Ford Explorer hatchbacks that I've had experience with. To solve the problem, the vertical portion of the mount must be moved, at least 1-1/4 inches back from the hatchback lip.

"I've had success in modifying a Comet RS-9 trunklip mount (which sells for about $12) in this application, by simply making a new lip mounting bracket. I cut off the RS-9's original mounting lip, and bolted the 'modified' unit to a new custom-made extension bracket with a #8 screw. For this new lip-mount extension-bracket, I used a straight piece of steel from a standard 90° wood corner repair bracket (these corner brackets should be available at any well-stocked hardware store). I bent one end of the bracket into a 'U' shape, so that it would fit over the hatchback lip on my particular vehicle. Next, I drilled and tapped the steel bracket for #6 set screws. I've painted the whole bracket assembly black, and the final result looks pretty professional, if I do say so myself! You'll have to adapt this idea to your own hardware and vehicle clearances, but Fig. 2 should give you a rough idea of the approach that I used."

Good DXing

From Tom Hart AD1B: As the HF bands begin to make a comeback, here's a tip for ferreting out some of those often hard-to-find DX QSL addresses: "Most of us no doubt have had the thrill of receiving those rare DX QSL cards in our mailboxes, but locating the correct address for the DX station, or his or her QSL manager, can sometimes be problematical. There is a way, however, to ease the problem if you make enough DX contacts to warrant the outlay. The GOLIST, published by John Shelton WB4RRK (address: The Heritage Group, P.O. Box 3071, Paris TN 38242), compiles a monthly listing of DX stations and QSL routings for $3 per single issue, or $30 per year, for US mailing. They also have a computer disk version, a telephone BBS, and an Internet site for faster updates. They can be reached by phone at (901) 641-0109—tell them that you saw it in *73!*"

Murphy's Corollary: The ready availability of any electronic component will be inversely proportional to the absolute need for that particular part.

Many thanks to the contributors who make this column worthwhile each month—their input is directly proportional to the needs of all of us for interesting ideas. This month, they include:

George Primavera WA2RCB
830 Park Drive
Cherry Hill NJ 08002
Packet address: [WA2RCB@KE3CZ.#EPA.PA.USA.NA]

Richmond B. Shreve, Jr. W2EMU
P.O. Box 149
Bound Brook NJ 08805-0149

Bill Turner W7TI
21607 56th Avenue West
Mountlake Terrace WA 98043

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

Tom Hart AD1B
54 Hermaine Avenue
Dedham MA 02026

Be sure to check out the "Ham to Ham" column's home page on the World Wide Web at: [http://www.rrsta.com/hth]. You can also pick up at this site any back columns you may have missed or misplaced.

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73 Magazine, *and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is assumed by the moderator or by* 73 Magazine *for any equipment damage or malfunction resulting from information supplied in this column.*

Please send all correspondence relating to this column to Moderator Dave Miller NZ9E at the address shown at top. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73 Magazine*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73 Magazine*.

Number 62 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

NASA helps teach science through the World Wide Web

Just as rapid changes in technology force us to make adaptations in our daily lives, so we adapt in our classrooms. The motivational techniques we use with our students must constantly be updated as the nature and backgrounds of the children we teach keep changing. Instead of being intimidated or overwhelmed by new technology, we must think of it as new and more stimulating ways of teaching about the world.

I recently read an informative article by Carol Galica in *Educational Horizons* which led me to some great discoveries on the computer. I suggest you pick any one of these sites to get started and see how your children react to it. Always remember that if you're creative and persistent you can enrich any lesson on space with a ham radio contact through the SAREX program. Call the educational department at the ARRL to get more details about SAREX. With the advent of Internet access in many schools around the country, NASA has been able to transfer educational data worldwide. The following sites contain the potential for great learning experiences:

• The NASA Lewis Research Center Learning Technologies K-12 homepage [http://www.lerc.nasa.gov/WWW/K-12] uses basic aeronautics principles to teach math and science. Educators will find published tutorials and lesson plans to assist them in making learning more fun for their students. Students can brush up on math skills as they take the 9th Grade Math Proficiency Test. Once students have completed the test, teachers can proceed with aeronautics activities that show various ways to demonstrate math and flight problems that correspond to aeronautics principles.

• (TIE) Telescopes in Education [http://encke.jpl.nasa.gov./TIE/TIE_index.html] gives students the control of a science-grade 24-inch reflecting telescope located at the Mount Wilson Observatory in California. The telescope is no longer being used by astronomers, so educators are being given the opportunity to reserve time on the telescope. Instruction is given to the telescope by the students via the computer. Images selected by the students are photographed and transmitted back to them over the Internet within minutes. Schools from all over the world have used the telescope. This site is certain to increase students' interest in and knowledge of astronomy, astrophysics, and mathematics.

• The NASA Shuttle Web [http://shuttle.nasa.gov] provides information on past, as well as future, flights. This site gets busy when there is a shuttle up because it provides live audio and video feedback, from launch to landing during the mission. The Shuttle Web has a section on sighting opportunities. Educators can find out when and where to look for the shuttle or the *Mir* Space Station in various cities.

• BAD Aircraft Design [http://fornax.arc.nasa.gov:9999/badweb/badweb.html] gives students an opportunity to design a subsonic airplane on line. The design has to be capable of providing nonstop service from San Francisco to New York. Students are allowed to change wing, fuselage, engine and stabilizer definition. Help is given on what each variable is and what it determines. The site immediately analyzes the decisions and outputs an image of the airplane, whether it would make the flight, its cost, and other information. This site is an excellent place for students to develop deductive reasoning skills.

• LIFTOFF to Space Education [http://liftoff.msfc.nasa.gov./kids/welcome.html] contains materials for a younger audience. NASA personnel volunteered their time to create materials using JAVA and FutureWave applications. Students can do interactive word-find puzzles, and an activity where they find out what their weight would be on another planet. There is also a quiz that prints out a certificate of completion when the student has finished it.

• NASA Quest [http://quest.arc.nasa.gov] provides students the unique opportunity to interact on-line with various NASA professionals and NASA projects. Currently being conducted are "Women of NASA" Web Chats in which individuals can communicate with female employees whose careers range from technical writer, to research psychologist, to astrophysicist. "Live from Mars" follows the progress of NASA's Mars Pathfinder and Mars Global Surveyor Missions. An archive of past projects is also kept at this site and includes the "On-line from Jupiter" and "Live from the Hubble Space Telescope" modules. All these projects are designed to motivate kids to pursue high-tech careers.

• The International Space Station homepage [http://issa-www.jsc.nasa.gov] starts off with a countdown to the launch of the first assembly mission for the space station. Technical information, as well as examples and explanations of what the space station will be used for, are posted here. At this site, students are able via E-mail to question scientists working on the space station. Since this is truly an international venture, students may find questions asked from all over the world.

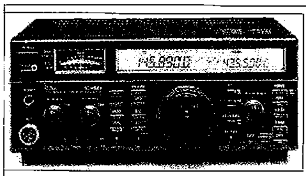
• The Space Educator's Handbook [http://tommy.jsc.nasa.gov/~woodfill/SPACEED/SEHHTML/seh.html] contains the NASA *Spinoff '95* book. Spinoffs are products or procedures developed by NASA that are being used in industry or in the home. Some of the spinoffs described include a workout machine that is taken from one of the first training instruments used by the astronauts, golf aerodynamics used in golf balls, rescue equipment, the cordless phone, and the robot hand. Here students begin to see the process that products take from research to the neighborhood store. At this site, educators will also find space comics and a space calendar.

These are just a few of the NASA-created sites. NASA has sponsored many more educational sites. They are all geared toward making math and science education fun and informative. Some others you might want to try are:

- Exploring the Environment [http://www.cotf.edu/ETE]
- Volcano World [http://volcano.und.nodak.edu]
- Athena [http://athena.wednet.edu]

Bringing modern technology into the classroom via ham radio has always been one of our goals as educators. Now we have another powerful tool! 73

NEW PRODUCTS



Dual-Band All-Mode Transceiver

The IC-821H joins Icom's lineup of small, lightweight base stations—it's not only a great addition to your shack, but, at 11 pounds, a great choice for mobile or field operation. Small size (9.5 x 3.7 x 9.4 inches) definitely doesn't mean small performance. Simple operation usually equates with limited functions, but the IC-821H is easy to use *and* loaded with enough functions and performance to satisfy the most demanding user—including digital satellite and CW operators.

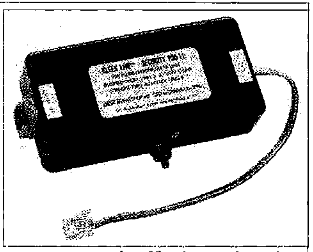
Satellite operation is easier than ever, with a separate VFO and 10 memory channels provided specifically for satellite operation, making it simple to recall your most-used frequencies.

Packeteers will be happy to know that the IC-821H has excellent C/N ratio and frequency stability, as well as direct audio modulation. Among the additional packet features are selectable data rates of 1200 or 9600bps and adjustable modulation signals.

Just a few of the IC-821H's features include programmed scan, memory scan, and mode select scan—the list goes on and on—and then there are the *options*.

For further information, contact your Icom dealer or Icom America, Inc., 2380-116th Avenue N.E., Bellevue WA 98004; (206) 454-8155.

Protection for "X2" 56K Modems



Electronic Specialists announces redesign of their popular Model PDS-11 Modem Protection system to accommodate the latest "X2" 56K modem technology.

Enhanced four-stage spike suppression and RFI interference filtering are combined to create reliable, high-speed data transmission through the modem, while also protecting connected computing equipment.

Fast response, high-current, dual-semiconductor suppression networks provide both common mode and differential mode equipment protection. Inter-stage suppressor buffering also increases overall system operability. Both phone leads are fused, adding further protection. And all this for a list price of $74!

Contact Electronic Specialists, Inc., 171 South Main Street, Natick MA 01760; call toll-free (800) 225-4876; E-mail: [clipprx @ix.netcom.com]; or check the Web site at [http://www.elect-spec .com].

Bytemark/Amidon Now on the Web

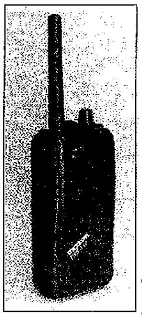
Bytemark Corporation announces that its Amidon Technical Specification On-line Reference is ready for release to the amateur community. Based on the Amidon product reference book, this technical reference contains useful electrical and physical information on popular Amidon components and includes detailed technical data on every part in stock. Also included on-line is information on the use of these components and application of available formulas for optimal part selection.

New sections are being added regularly; there is no minimum for on-line orders. Also, CoreCalc!™ for Windows® toroid calculation software is available for download to registered owners of any powdered iron core from Amidon, with a rebate toward purchase of Amidon parts. Check it out at: [http://www.byte mark.com].

Did You Get One?

The Contact East catalog spring supplement is out—56 pages of cool stuff for engineers, managers, technicians and hobbyists. Products you need from names you trust—and it's free. To get your copy, call (508) 682-2000; FAX (508) 688-7829; or write to Contact East, Inc., 335 Willow Street, North Andover MA 01845.

Family Radios

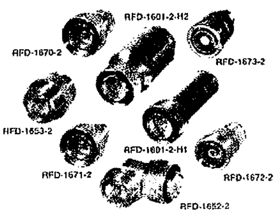


Maxon America, Inc. introduces its first palm-sized Family Radio Service radio—the FRS-114, a license-free two-way radio operating on UHF frequencies. Imagine one of these in the hand of a family member at a mall or park, camping, or at a flea market or sports event—the radio has 300mW output power, providing a mile or more of range. How many times have *you* gone searching for a straying kid—or wondered where your mate had disappeared to?

Here's a three-and-a-half ounce solution. The FRS-114 package includes the radio with belt clip, screw-in rubber ducky antenna, and owner's manual (you supply four AAA batteries). Additional accessories include an ear speaker and a wall charger for in-unit charging of NiCd batteries.

And it's license-free, so any family member can carry one—that's a lot of peace of mind for only $119.95. For more information, contact Maxon's sales department, 10828 NW Air World Drive, Kansas City MO 64153; (816) 981-6320, ext. 399; FAX (816) 891-8815.

More 7/16 DIN Connectors



RF Connectors introduces the expansion of its line of 7/16 DIN connectors. The 7/16 interface is ideal for use in such high power RF applications as cellular base station transmitters, combiners, amplifier outputs, and two-way radio installations.

The 7/16 DIN connector, choice of RF engineers in many applications, offers excellent performance with low VSWR. They are made in the US of machined brass with beryllium copper contacts and Teflon™ insulation. All RF Connectors 7/16 DIN connectors and adapters are silver-plated for improved intermodulation performance.

For more information, see your dealer, call (800) 233-1728, or E-mail: [102061.2261@ compu serve.com].

Keep Your CDs Like New

Remember, when CDs first appeared, they were touted as indestructible? Well, we've learned a thing or two since then—it wasn't that hard to louse up your CD-ROM *Callbook*, was it?

Help has arrived. Crystal-Disc™ is an alcohol-free acrylic compound that eliminates minor scratches and abrasions on the surface of the CD. Regular applications will increase CDs' longevity and protect your drive (and audio equipment, if you use it on music CDs). The manufacturer claims that one application reduces microprocessor signal correction by 80%, so look for Crystal-Disc. They've been using it in Great Britain and now it's becoming available here for around $6.99 retail, distributed by A&M Distribution, 601 New Loudon Road, Suite 172, Latham NY 12110.

Ham Radio Fun

Communications Simplified, Part 19

Multiplexing and digital data.

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

So far, we have dealt with simple analog waveforms; now it is time to introduce multiplexing and data compression, and show how analog information can be sent through digital circuits.

Analog signals

Most things in nature tend to change more or less gradually. When you then convert these things into electrical signals, they too tend to change more or less gradually. That conversion is usually done with some sort of a transducer. In earlier chapters, we have already mentioned microphones and speakers as examples of transducers; though we didn't specifically say so, the video cameras and picture tubes of TV are also transducers—they also convert energy from one form to another.

But when we say "more or less gradually," we don't necessarily mean "slowly." Things in nature can change fast, too. What we mean is that they usually don't change *instantaneously*. Even a bullet, fast as it is, doesn't disappear from the gun and suddenly appear in the target. It may look that way to us because we're slow, but it doesn't take much to prove that the bullet moves through every bit of space between the gun and the target. It gradually moves from one place to another, passing through all the in-between places—even if that "gradual" motion happens pretty darn quick!

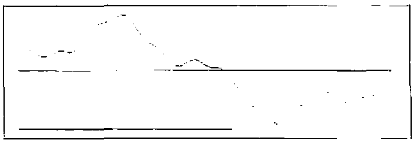


Fig. 1. A typical analog signal.

Fig. 1 shows what the output of a transducer might be when it converts some physical process into an electrical signal. This wave might represent the motion of a ship, or the motion of the diaphragm in a microphone, or the motion of a phonograph needle as it plays a record, or perhaps the light pattern of a TV picture. It is an analog signal, and it could be transmitted by any of the methods we have discussed so far—by wire or wireless, by carrying it as is or by modulating it on a carrier, etc.

There are times, though, when we don't want to transmit the signal as is; this could be for several reasons. One might be that we want to combine this signal with others so they can all be carried together through one wire (or one circuit); such combining is called multiplexing. Another reason might be that we want to reduce or avoid degradation due to noise or distortion; this is usually done by converting the analog signal to a digital one. Using multiplexing, and using digital circuits, are two totally different concepts, but they are often intermixed in some way and used together.

FDM: Frequency division multiplexing

Without calling it that, we have already discussed FDM in previous chapters. The whole idea of radio transmission—the idea of using carriers of different frequencies to carry different signals, all at the same time—is nothing but frequency division multiplexing. Each signal occupies a different range of frequencies; all of these signals are then mixed up and carried through the air to your antenna; the receiver then uses tuned filters to separate the signals and recover the one we want. Frequency division multiplexing merely takes a large range of frequencies, divides that range into smaller sections, assigns each signal that smaller range of frequencies, and then combines ("multiplexes") them together.

FDM can also be used through wires, of course. When Alexander Graham Bell invented the telephone, he was actually looking for methods to multiplex several telegraph connections onto one telegraph wire. His idea was to send the dots and dashes through the wire as musical tones of different frequencies, which could then be separated at the receiver with filters. It was not such a bad idea, but the state of electronics was simply not advanced enough at that time to get his system working. (Just as well—he invented the telephone instead!)

Eventually, the telephone company itself became a major user of frequency division multiplexing. It soon became obvious that it was uneconomical to devote a separate wire to carry each conversation, especially between cities. So they developed their "carrier" system, where each voice signal was modulated onto a different carrier; the carriers were then combined together onto one cable. Their first system used plain AM, and the carrier frequencies were multiples of 8kHz. For example, one voice signal

would be modulated onto an 8,000Hz carrier, whose sidebands would extend from just above 4kHz to just below 12kHz (since the audio went to just under 4kHz). The next voice signal, modulated onto a 16kHz carrier, would occupy the frequency range from about 12kHz to about 20kHz, and so on.

This telephone company FDM method has now been superseded with newer methods, but cable TV still uses FDM. TV signals, each occupying 6MHz of spectrum, are combined onto one coax cable and carried into your home. (This method too is about to be superseded with digital technology, though.)

WDM: Wavelength division multiplexing

Remember that frequency and wavelength are related by the equation

$$\text{wavelength} = \frac{\text{velocity}}{\text{frequency}}$$

Thus for every carrier's frequency there is a corresponding wavelength (assuming you know the velocity at which the signal travels in whatever medium you are considering). WDM or wavelength division multiplexing—that is, using a different wavelength for each signal—is therefore the same as frequency division multiplexing, where a different frequency is used for each signal.

In optical fibers, though, the color of the light is generally described in terms of its wavelength, not its frequency. So using different colors for different signals—that is, sending several different light beams through a fiber at the same time—is referred to by the name WDM rather than FDM. (Using the term "color" is a bit misleading, since "color" implies something that the eye can see, whereas most practical fiber-optic communications systems use invisible infrared light.)

WDM is an extremely useful technique with fiber optics, because it greatly increases the amount of information that can be sent through a single fiber. The bandwidth over a single light beam is primarily limited by the dispersion in the fiber; using two or more different color light beams allows use of the full bandwidth for each different beam. As of 1996, for example, several systems have been demonstrated that use 50 or so light beams, each carrying 20 billion bits per second, to carry a total of 1 trillion (10^{12}) bits per second of data through one fiber.

Sampling

Aside from FDM and WDM, most other multiplexing methods involve some sort of sampling. Sampling involves providing small portions of a wave, called samples, with enough detail to allow the receiver to fill in the missing parts.

For instance, consider the sentence "H_w a_e y_u?" Even though there are some missing letters, with a bit of time you can probably figure out that the sentence should read "How are you?" This is an example of sampling.

Fig. 2 shows how sampling might be used in communications. The top trace shows the same waveform we saw earlier in **Fig. 1**. The center trace shows how we have removed most of the wave, and retained just small samples, taken at some periodic interval (which we will discuss shortly).

In an electric circuit, however, it isn't possible to send these samples with nothing between them—something has to connect them together, even if that "something" is zero volts. The result might be the bottom trace in **Fig. 2**, which shows that each sample becomes a pulse, separated by a zero-volt signal between them.

Let's return to our example of "H_w a_e y_u?" We need to do two things to make sure you can correctly decode this sentence: (1) make sure that the samples come often enough that the missing parts between them are small and can be reliably filled in, and also (2) make sure that the samples themselves are correct. For instance, "H__ __e _o_?" does not contain enough samples, because it might be misunderstood to mean "His fee too?" Likewise, "H_s a_e y_u?" has a mistake and would also cause an error.

In terms of electrical sampling, these two requirements mean that samples must be taken often enough, and accurately enough, so that we can later fill in the missing pieces without introducing any new errors. Let's now look at these timing and accuracy requirements in more detail.

Sampling rate

The rate at which samples are taken is called the sampling rate. So how often should they be taken?

The answer comes from the Nyquist Sampling Theorem: In order for the samples to adequately represent the analog waveform, the sampling rate must be at least twice the highest frequency contained in the signal. (The fine print says that the sampling rate must be ever so slightly more than twice as high.) Looking at it from the other direction, the highest frequency component present in the analog signal being sampled must have a frequency less than half of the sampling rate.

There's still another way to look at this: Consider the fastest possible cycle in the analog waveform; if you have slightly more than two samples of that cycle, you can reconstruct the entire cycle from the samples.

A CD, or compact disc, makes a good example. The audio signal on a CD has a frequency range from 20 to 20,000Hz. Since the highest frequency is 20,000Hz, any sampling rate above 40,000 times per second—twice the highest audio frequency—will provide enough information to allow the CD player to completely reconstruct the audio signal from the samples. (Compact disks sample 44,100 times per second to provide a slight safety factor.)

To understand the Nyquist Sampling Theorem, note that its purpose is to make sure that the original waveform can be reconstructed from the samples. So let's see what is involved in reconstructing a wave from samples by looking at a "connect the dots" puzzle like the simple one in **Fig. 3**, which shows five numbered dots to be connected. Most people given this puzzle would use straight lines to connect the dots, as in the top trace. But when you think about it, there are zillions of different ways to

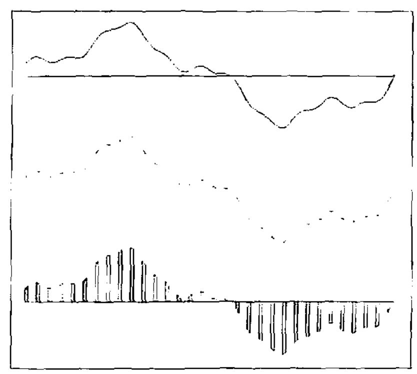


Fig. 2. Sampling an analog waveform.

connect two adjacent dots—you can use straight lines, curves, zig-zags, curlicues, or anything else that strikes your fancy. In other words, if the dots represent samples of a wave, there isn't necessarily just one unique wave that can be reconstructed from these samples.

But suppose we lay down two simple rules:

1. No sharp corners are allowed. This automatically rules out using straight lines to connect dots, because this would always leave a corner where two such lines meet at a dot (unless three dots are lined up in a line, which is unlikely to happen very often).

So this rule means that adjacent dots can only be connected with curves. But it also puts a constraint on the curves. When two curves meet at a dot, no sharp corner is allowed between them, either—they must blend smoothly into each other without making a corner. This still leaves a lot of possible curves that would fit, so we make one more rule:

2. No sharp bends. Any curve connecting two dots must be the "least curvy" curve that fits rule 1. In other words, only the smoothest curves are allowed, curves which bend as little as possible. Any bends in a curve must have the largest possible radius.

With these two rules in effect, we suddenly discover that there is only one possible way to connect all the dots, similar to the bottom trace in **Fig. 3**. This unique connection is the analog signal that would be reconstructed from the samples.

How do we enforce these two rules? We note that waves that contain a lot of tight curves or even corners contain very high frequency components (think of the square wave, which has right-angle corners and harmonics that extend way up to infinity). The Nyquist theorem, by saying that the highest frequency in the analog signal

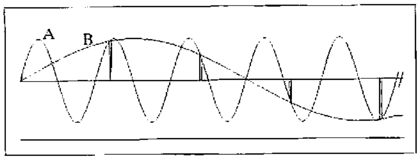


Fig. 4. *Aliasing error.*

must be less than half of the sampling rate, puts a limit on high frequencies.

In a very concise way, the Nyquist theorem essentially says this:

An analog signal that has sharp bends also has high frequency components. This means that the sampling rate must be very fast—twice as fast as the highest frequency component in the wave. When you sample this fast, then the samples are so close together that the portion of the waveform that connects any two adjacent dots (samples) is so small that it doesn't have a chance to do much bending.

If the sampling rate is not fast enough, then reconstructing the original wave from the samples will lead to a type of error called aliasing. **Fig. 4** shows an example: Curve A is the original wave being sampled, but the samples are not taken fast enough (i.e., there aren't more than two samples in each cycle of the waveform). Curve B shows that there is another wave that also fits the same samples, and fits them *better* because it has more gentle curves and bends. Thus the reconstructed wave would be B instead of A, and this would lead to very serious errors.

Well-designed sampling systems thus always contain anti-aliasing filters, which are supposed to remove any analog signal whose frequency is more than half of the sampling frequency.

But filters are never perfect. In a CD recorder, for example, a filter which would remove everything above 20,000Hz would also remove some of the signal below 20,000Hz, thereby reducing the frequency response of the CD. This explains why CDs are recorded with a sampling frequency of 44,100Hz, instead of just 40,000Hz. This gives an extra margin of safety, allowing the anti-aliasing filters to remove almost all signals above 44,100/2, or 22,050Hz, yet retain almost all of the desired audio signals below 20,000Hz.

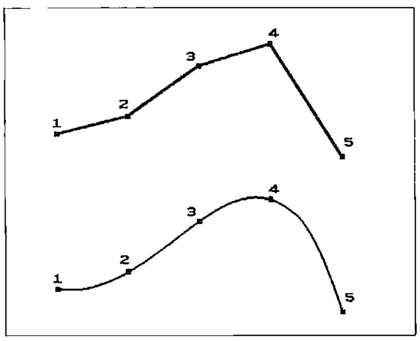


Fig. 3. *Connecting five dots.*

Sampling accuracy

In addition to sampling an analog signal often enough, we must also sample it accurately. The required accuracy depends on two factors—how well we need to reproduce the original analog signal, and how we intend to send the value of those samples to their destination.

Let's use the compact disc as an example. CD specifications often list the signal-to-noise ratio as about 96dB. This means that any noise, such as what might be introduced by slight errors in reconstructing the signal from the samples, should be 96dB weaker than the loudest music to be recorded. (Signal-to-noise measurements always use the loudest music so as to give the best numbers.)

Remembering the formula for calculating dB from a voltage ratio, we note that

$$20 \log \frac{\text{signal}}{\text{noise}} = 96$$

Solving this for the numerical ratio, we get about 63,100. Hence, if the music is to be 96dB louder than the noise, then it must have about 63,100 times as much voltage. We will see shortly that the actual ratio used is 65,536, giving an actual signal-to-noise ratio of about 96.3dB. In other words, any errors introduced by the sampling must be smaller than about 1/65536 of the maximum voltage. This implies that any voltage measurements in sampling the music must be accurate to at least one part out of 65,536 or so.

This short calculation tells us how accurately we must perform the sampling of the original analog waveform to achieve a certain signal-to-noise ratio. But we must also consider how we are going to send these samples to their destination. There are basically two approaches to do that. In the analog approach, we send the values as analog quantities. For example, we might use a voltage or frequency to represent the value of each sample. In the digital methods, we convert the value of each sample into a number, and send those. This gives us a number of different methods.

TDM: Time division multiplexing

Just as FDM takes a range of frequencies and cuts it into smaller slices, so Time Division Multiplexing or TDM takes time and cuts it into smaller slices, one for each signal to be carried.

The bottom trace in **Fig. 2** actually shows one such signal, as sampled and converted into pulses. These pulses are

narrow enough that pulses representing another signal could be squeezed into the empty space between them; in this way, a number of different signals could be carried together along the same path.

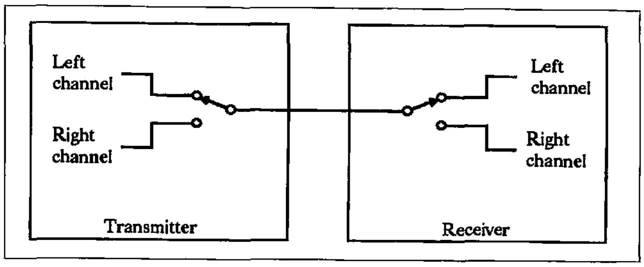


Fig. 5. FM stereo viewed as TDM.

Previously, we discussed FM stereo. We mentioned that the L-R, or the left-minus-right difference signal, was modulated as a DSB signal onto a 38kHz subcarrier, and that matrixing was used in the stereo receiver to combine it with the L+R signal to produce separate left and right channels. But then, in just one sentence, we casually added that this was the old-fashioned analog approach, since modern equipment used a different way of accomplishing the same result. Because most books and articles describe stereo FM the older, analog way, many people don't understand the newer technology.

The truth of the matter is that modern FM stereo equipment uses time division multiplexing! **Fig. 5** shows a simplified diagram of how it works. The switch on the left, inside the transmitter, is the multiplexer. It samples the two channels at a sampling rate of 38kHz (which is more than twice FM radio's highest audio frequency of 15kHz) by continuously flipping up and down. At the same time, another switch in the receiver (the demultiplexer) also flips up and down at the same 38kHz rate. The two switches are synchronized so that both are up or both are down at the same time; this makes sure that the left and right channel signals are properly steered to the correct output. The receiver then uses the samples to reconstruct the original waveform for each channel.

The actual circuitry doesn't use switches, of course; since they would not be fast enough. Transistor switching circuits are used instead; they are synchronized by the 19kHz pilot tone.

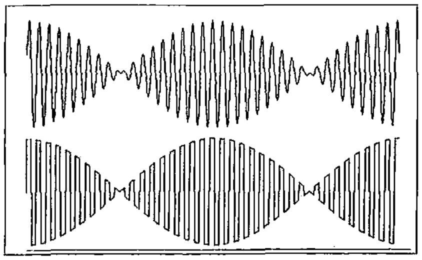


Fig. 6. Comparison of TDM and DSB modulation.

It is not easy to show mathematically that this TDM circuit gives the same results as the DSB approach, so **Fig. 6** shows the waveforms, developed by computer simulation.

The two waveforms assume that the left and right channel both contain a 1,000Hz sine wave, but that these two channels are out of phase. The sum, L+R, is therefore zero, while the difference, L-R, is a pure 1,000Hz signal. The top waveform in **Fig. 6** shows the resulting DSB signal. Since there is no sum signal, we have only a 38kHz DSB signal consisting of two sidebands, one at 37kHz and the other at 39kHz. When these two are mixed, we get the top waveform.

The bottom waveform, on the other hand, shows TDM, switching back and forth between the two out-of-phase 1,000Hz signals in the left and right channels. You can see that the bottom wave is very similar to the top; it just has some sharp corners, which could easily be smoothed out with a low-pass filter.

Aside from the fact that it is cute to compare DSB with TDM, there is another point worth noting here—the fact that TDM requires a substantial bandwidth. Even aside from the sharp corners (which add harmonics, just as squaring up a sine wave into a square wave adds harmonics), TDM introduces sidebands around the sampling frequency. In the case of FM stereo, for instance, sampling between the left and right channels (each of which has a frequency response up to 15kHz) at a 38kHz rate gives us the same signals as we discussed previously (May 1997): the L+R signal up to 15kHz, and a L-R DSB signal extending +/-15kHz from 38kHz, i.e., from 23kHz up to 53kHz.

Number 68 on your Feedback card

Vintage Review: Yaesu FT-727R Dual-Bander

Save money on an all-purpose HT.

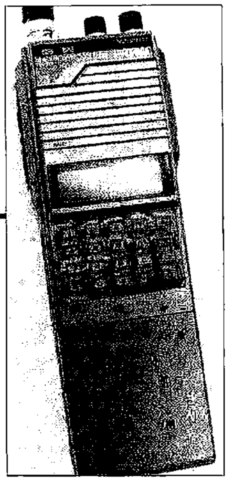


Photo B. View of front controls, Yaesu FT-727R.

Harry M. Johnson NV7K/6
1615 Wood Street
Eureka CA 95501-4672

Many new amateurs are coming into the hobby today via the no-code technician license, and most begin their "careers" on 2m and/or 70cm FM. They don't have the capability that young hams had in the past to pick up and modify surplus gear or home-brew a first rig. Most buy one of the many hand-held transceivers on the market and use it in its intended way as well as for a base station and a mobile radio. Even though these rigs are relatively inexpensive considering the value of today's dollar, they still are somewhat pricey if you are a young person or someone who is also trying to feed a couple of hungry children.

One way to obtain an inexpensive rig is to buy a good used one. Besides the need to know about the working condition of the radio, you should try to learn whether or not this model has the "bells and whistles" that you are looking for. A daunting task indeed, since so many models of hand-held FM transceivers have been produced in the past ten years.

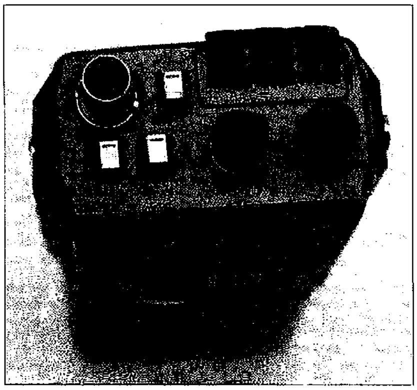


Photo A. Top deck controls, Yaesu FT-727R.

The Yaesu FT-727R was one of the first of the dual-band amateur HTs. It can transmit and receive on the amateur 2m and 70cm FM bands. In 1987, when this radio came on the market, extended receive capability was not an available option. The frequency coverage on two meters is 144.000-147.999MHz; on 70cm, it covers 440.000-449.999MHz. The power output is 5W at full power on both bands and 1/2W on low. It is much larger than contemporary dual-banders, but still a very usable size at 200mm high x 71mm wide x 38mm deep with attached standard equipment battery, the 12.5V, 500mA FNB-4A. Its weight is 616 grams.

Physical layout

The controls and connection points on the top deck (**Photo A**) are: BNC connector for the antenna, VOX switch toggles that function on and off, mini phone jack for Yaesu's CAT (computer-aided tuning) function, mini and micro-mini phone jacks for the earphone and external mike connections respectively, high-low transmit power switch, lamp switch (illuminates LCD display) and squelch and on-off volume rotary pots.

On the left side of the rig near the top is a bulge that houses the push-to-talk switches. In this case there are two distinct switches, one above the other, and either can be used. In the European model the top switch was the tone burst switch necessary to access European repeaters. The battery lock button is also found on the left side. On the right side opposite the push-to-talk switch is the function switch. The push-to-talk and function switches are covered with a rubber membrane which effectively keeps out moisture and dust.

The front panel (**Photo B**) has two LEDs at the upper left. One is green while the squelch is broken and red while the PTT switch is depressed. The other comes on when the battery voltage gets below 7.0. A very ample speaker and a mike are housed behind a grill. The LCD display is below the grill, and a 20-button keypad below that. On the rear at the bottom of the belt clip and under a rubber cover is the VOX sensitivity switch.

The LCD display tells you just about everything you would ever want to know, including battery voltage. All data entry is done via the keypad. The D key puts you in the dial mode and allows frequency entry. Another key toggles between the VHF and UHF bands. Ten memories are available between the two bands as well as a call memory for each. The keypad sequence for memory entry is: D, key in the frequency, M and then the memory number. Pressing MR puts you in the memory recall mode and then the memory number key gets your desired pre-entered frequency. The memory will hold the repeater split (+, -,

or simplex) as well as tone encoding and decoding information (more on tones later). Each key has its primary use marked on it and its secondary use just above. By holding the function switch and then pressing a key, its secondary function is called into play. The 16 DTMF tones are produced by the leftmost 16 keys. A, B, C, and D tones are not marked on the keys but are generated by the keys in the fourth column from the left as you go down.

The two rightmost keys on the top row are down and up keys, respectively. They will step the frequency up and down from the beginning setting, or when in the scan mode will scan the memories up or down. To initiate scanning, either the up or the down key must be depressed for one second and then released. To stop scanning, press the PTT switch momentarily.

There is a double horizontal arrow key to reverse the transmit and receive frequencies so you can "listen on the input." The "*" key will bring up the call frequency on either band. The "#" key followed by a memory number will put you into the priority mode, where a predetermined frequency is regularly checked while you're on another one.

Special features

The FT-727R was unique in that it was able to give a reading of the instantaneous battery voltage to the nearest half volt. Using the function switch and a keypad press displays the voltage on the LCD panel. In conjunction with the red battery warning LED, it is a simple matter to avoid fading off into low battery oblivion while transmitting.

The VOX on-off switch on the top panel allows you to use a useful Yaesu accessory, the YH-2 VOX headset. This accessory did not come with the radio but could (and still can) be purchased at nominal cost. The headset is very light. It has one foam-covered earpad and a very light foam-covered mike on a flexible boom. It plugs into the EAR and MIC plugs on the top deck. I have found this accessory to be extremely useful while traveling bicycle mobile. It can only be used while the rig is in VOX mode and, of course, the usual care must be exercised about what is said while in the VOX mode. Slips of the lip can cause unwanted transmissions to go out over the airwaves!

A half duplex situation can be entered by holding the function key and pressing the DUP key. In this condition, you can transmit on one band and receive on the other. In certain situations this can be a useful feature.

In use

I purchased my FT-727R in May 1988 and have been using it ever since. It has at times been used as a mobile rig connected into the vehicle's electrical system through a home-brew adapter. Most often a 5/8-wave mag mount was used for the mobile. Most of the time was spent in a rural area of western Montana, doing rag chewing, "meaningful communication," and autopatching. In the absence of a base station rig it has been used in that capacity also, connected to a 30A station power supply or storage battery and the two-meter J-pole mounted on the roof. In that case, there wasn't much I couldn't do with the radio set at 0.5W. As I indicated earlier, it is used also in the bicycle mobile mode. Using either the FNB-4A battery or a small gel cell, it is carried in a handlebar bag with the rubber ducky protruding. The VOX headset is worn under the helmet and the rig placed in the VOX mode for operating hands-free while riding.

Options and accessories

After I had been using the radio for over five years, I decided it would be advantageous to add CTCSS tone encode and decode capability. I purchased the Yaesu FTS-6 tone unit and did the simple installation. It worked right out of the box and provides the ability to use "toned" repeaters that I could not previously use. The control keys are provided on the radio but do not function until the unit is installed. Also, the icon on the LCD panel then becomes activated.

Early on, I unthinkingly left the radio lying on the bed where our family cat, Spot, normally sleeps. She enjoyed chewing the end off the original equipment rubber ducky antenna. I ordered a very similar-appearing replacement dual-band ducky made by Larsen and used it successfully. Later, I came across another Yaesu YHA-27 original equipment ducky and compared it with the Larsen in everyday use. The Larsen is superior on both bands.

An accessory that I purchased and must recommend very highly is the HT carrier called The Pouch. It is made of wetsuit material. The makers do an excellent job of stitching it up, and mine is like new after almost seven years of use. It has a belt loop and a cover that is secured with hook and loop attachments. The rig has fallen several times while enclosed in the protective Pouch, without suffering any nicks or damage.

The 36mm speaker mounted in the 727 case does a pretty good job in most situations. I purchased a Radio Shack™ CB-type extension speaker and mounted it in my car. When the FT-727R was doing duty as a mobile rig, I plugged the speaker cable into the EAR jack and let the 450mW of audio power drive the larger speaker for better quality.

Summing it up

Not all of the falls took place while the rig was safely enclosed in its protective cocoon. As an artist, I often carry a lot of stuff around to various places and am not always careful about some of my armloads. On one occasion, while loading the car, the HT slipped out from under my arm and fell from above waist level to the hard ground. It landed squarely on the ends of the squelch and volume controls, with the result that the squelch pot was broken and inoperative. I returned it to Yaesu for repairs. By the time it was returned, I had purchased the aforementioned Pouch, which I have used since. I invariably hook my middle finger through the belt loop of the Pouch and secure the top strap. That way, even though my arms are full, the rig cannot fall.

"A real rock in terms of reliability."

I am still using the original FNB-4A battery that came with the radio. I have simply followed the NiCd commandment of using the battery until it becomes inoperative because of low state of charge and then recharging it fully.

All in all, this HT is a real rock in terms of reliability. Its double conversion superhet receiver works well; its transmitter power is more than adequate for most repeater situations on both 2m and 70cm; it is easy to use and generally does the job. If you want an all-purpose, dual-band FM radio and want to save $150 to $200 over the purchase of a new one, look for a good used Yaesu FT-727R in the ads or at the next hamfest.

LETTERS
Continued from page 55

Richard Ebeling K2UTC, White Plains NY. My purpose for writing to you is to offer a suggestion pertaining to your editorials. I am not a subscriber to *73* Magazine, but occasionally read *73* via a borrowed copy.

First, your editorials are very interesting, and informative; that is, there are articles/comments that I read nowhere else. My only criticism is to reduce the number of continuing pages that one has to turn to in order to follow your thoughts. April 1997 *73* is an example. Starting from page 4, then page 38, 47, 59, 61, 65, 81, 83, 88, etc. To me that is very distracting, plus it makes it more difficult to keep the entire editorial. I do not think I am the only one to ask why so many multiple pages, but generally everything has a reason.

Secondly, I have an observation/statement regarding our beloved 10-meter band. Are you aware of the "dangers" of operating 10 meters? Probably that is not the right word to describe the "non-amateur mess" our band is in with commercial intruders, CB trespassers, and pirates of varied descriptions. One needs an up-to-date list of legal amateur radio prefixes handy. For more than one year here in the New York City area, we have a renewed NYC taxicab commercial intrusion on 10 meters.

Thinking back to the 1985-86 NYC taxicab invasion, it was almost unbelievable. At least the taxicabs do not attempt to break in on a 10-meter amateur QSO like thousands of CB trespassers and other misguided individuals were doing during sunspot cycle 22. Nothing compared to the "mass invasion of European CBers" primarily from Italy, Spain, France, and other assorted countries across almost all of the 10-meter band, operating in AM, FM, and SSB mode.

Just yesterday, with DX skip appearing on 10 meters, already the intruders/trespassers are being heard, so with sunspot cycle 23 just starting, the 10-meter band will be a "challenge" as regards how many legally licensed amateurs are going to be drawn into radio contacts with all that non-amateur trash. To repeat, have an up-to-date list of all legal amateur radio prefixes (domestic and foreign) handy.

To someone like myself, who has operated 10 meters continuously since sunspot cycle 19 (through maximum and minimum sunspots), it is discouraging to observe what has happened to a decent amateur radio band since the "FCC 11-meter Pandora's Box."

Well, to 10-meter beginners and old-timers alike: Be advised that it would be prudent to exercise a little caution when making a radio contact, as many amateurs were completely fooled by non-amateur trash during cycle 22.

THE DIGITAL PORT

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703
E-mail: [jheller@sierra.net]

Resolving the Windows 95® comm port problem

Do you ever feel as if you're alone in a wilderness of computer problems? It gets serious when your computer can't talk to your TNC. The computer I am sitting in front of right now nearly got the best of me this past month. Logic wasn't failing; it was just requiring such a huge volume of input to gain so little.

Let me start at the beginning. This computer has served me well for over five years with only a few major problems—such as the evening Windows 3.1® ate itself and the time I replaced the once-magnificent 105Mb hard drive and the tape backup lost a few necessary items in the transfer to the new 800Mb drive.

About a month ago, the bugs beat down the door to their cage and a good working computer descended to the depths where even I was unable to help. The clue was when the floppy drives and the serial port for the TNC would not respond except after I wiggled the driver board. The final blow came when the wiggling process ceased to cure the problem and the parallel printer ports quit.

I called the local computer guru, and prepared a list of problems along with a list of what I would like to have done about them while I was gone for a week. Fortunately, when they called to tell me the first logical answer was to erase the hard drive, I was still in town. It is quite exciting to a person like myself when a tech wants to destroy the "irreplaceable" files, not to mention numerous excellent, use-every-day programs.

So, when I returned, the unit was nearly ready to pick up. There was a new hard drive, with the golden files copied to one partition, and a nearly empty partition for me to fill as I saw fit, along with a new motherboard, Pentium processor and a whiz-bang modem. The old hard drive was still mounted "just in case something hadn't copied."

What can go wrong will ...

Now about the Law ascribed to Murphy. I do a lot of work that requires a modem to the telephone line as well as using the PK232 MBX. That means comm 2 and comm 4 both need to work. You guessed it. Those who are up on interrupt requests (IRQ) realize that these ports use the same IRQ. In the past, it was necessary to exit the program on one port so the other port could be recognized.

No matter how I explained to this machine that "it used to work," there was no understanding of my dilemma. A call to the computer shop revealed that the model of US Robotics modem they installed was "plug and play," which is Windows 95 for "we'll configure it our way"—and I didn't have a voice in the matter. The answer was a modem from the same company with some jumpers that allowed me to set it for comm 4.

I am one of the classic holdouts who kept Windows 3.1 just a few years longer than expected. It was hard enough to give up DOS. There are some figures, recently published, that show about half of the folks think much the same as I do about changing to the new operating system. Many changed back to 3.1 after a trial run.

In defense of Windows 95, once you get it working, everything runs much faster. I have quite a few 16-bit programs that really run well and faster now that they can take full advantage of the processor. Some programs just had to be replaced. The backup software for the tape drive had no clue what it was reading, but the new package makes the same drive perform at least three times faster.

Back to the problem ...

A ham, especially a digitally-minded ham, has got to do what he's got to do. With the ports straightened out, I couldn't get the AEA Packratt for Windows program to access the PK232 MBX plugged into comm 2. The problem looked similar to when the port couldn't be found.

Follow the logical trail

How do I determine the difference between a software problem and a hardware problem? Answer: substitution. I tried the copy of Winpack v6. It would give a glimmer of hope and then fail. Next was the DOS program I referred to last month. It came up all right, but couldn't talk to the PK232 at all.

Maybe this is a problem with the PK232? I have a now ancient 386 with only DOS (kind of nostalgic) that works, but the logistics (cable length) put it out of reach of the PK232. Out of the garage came the MFJ 1274. With that hooked to the 386 and the DOS program installed, the two pieces of hardware communicated fluently. That at least proved one piece of software worked like it was supposed to.

The idea of moving the 386 computer and the PK232 within cable distance of each other was a little daunting. Perhaps the answer was software. Maybe the old package I was using so well for several years just wouldn't work with the 32-bit architecture. Back to the logic seat.

I had noticed recently there was some great sounding shareware available. There is a copy in the Hamnet library on CompuServe, but I wanted a little information. I hunted down the XPWare site on the Internet and read through the claims. There were screen shots of the program in action and a DOS version as well as one for Windows 95.

The descriptions convinced me I had to give it a try, so I downloaded the Windows version and installed it. The program ran, looked very stable and seemed friendly enough, but when I attempted to connect to the PK232 MBX, it spent several minutes identifying the TNC, then locked up ...

Yuk. It looked so promising, yet I had not made perceptible headway.

I looked through the User's Guide I had printed out and found that Gary Johnson KF7XP not only had his name displayed but also several ways to contact him. I chose the E-mail address and told him an abbreviated version of what I just told you. He got right back to me with a few ideas.

After configuring the program for dumb terminal mode, as suggested by Gary, the program came up and talked to the PK232 MBX like they were old friends. After quite a bit of experimenting with this and other configurations, I was beginning to feel better about the hardware, but things still weren't nearly right.

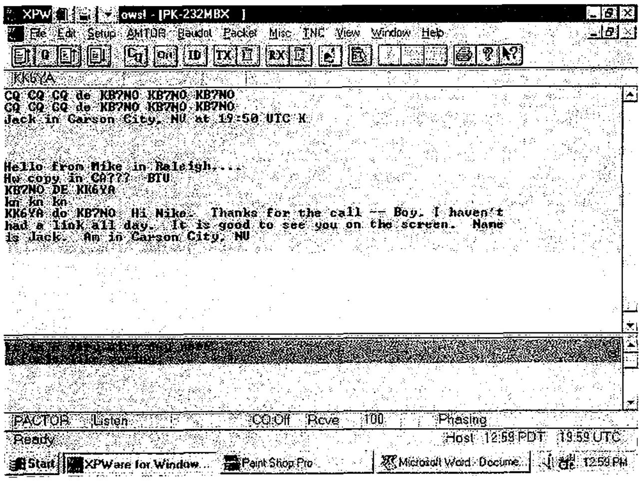


Photo A. Screen shot. This is XPWare in action. Actually, this was a day where S-meter readings were barely perceptible. I had sent CQ on 14.077kHz and Mike KK6YA answered. Due to conditions, the total of the QSO shows on the screen. The link dropped before the content of the lower (transmit) screen was sent. Note that Mike's callsign automatically appears in upper left. A pop-up log comes up with the automatic entries in it, but it didn't capture.

Remembering there was a DOS version of the XPWare on the Internet site, I went back and downloaded that program. I had resolved that it would be worth it to move the furniture around in the shack and try an all-mode DOS program from a DOS machine. If it was going to work, this should do the trick.

When it was time to transport the program to the 386 machine, I got lazy again. It was easy to install in this machine and it came up and spoke fluently to the PK232 MBX—so much so that after a bit of fumbling with the new-to-me commands I made a PACTOR link with Doc. in Chicago (during the heat of the moment, I didn't take proper advantage of the automatic logging and the callsign is not with me). The signal strength was in the just barely range at both ends and the link seemed flawless for several minutes. I felt like I had a new toy!

A hero arrives

So I sent Gary another E-mail. It was late afternoon and after dinner I went back to checking this program, printing the 100-page user manual (I was really getting impressed with this DOS program) and tinkering with the packet parameters. About 9:30 the phone rang and here was Gary introducing himself. He was going to make this thing work. Though this wasn't the strangest happening in this long course of events, I was sure I had tried the settings Gary outlined. But when it works, I'll admit to almost anything.

You just can't ask for much better service. There was some conversation about what I had observed since the last E-mail. Then he just simply led me along the path I should have been traveling and suddenly the program all fell into place. The host mode worked and I was a very relieved and happy camper.

A mini-review of XPWare

For a quick review of the impressive features of the Windows version of XPWare, let me begin with how the program comes up with the PK232 MBX plugged into the serial port. On the screen, you can see it takes about 15 to 20 seconds to scan and identify the machine, then it not only displays PK232 MBX but also the latest version of ROM by date. There are a number of other AEA controllers, so the program needs to know precisely which one it is working with.

When the operating screen is up, you see a familiar Windows format with the various available modes, Amtor, Baud, and Packet, that will allow changing modes and forcing transmit and receive functions by the logical pull-down menu methods. It is a nice, neat, straightforward layout that includes a setup menu, along with menus for editing text, handling files and excellent on-line help.

As with any thoughtfully designed program, there are ample shortcut keys so the mouse is not mandatory for most operations such as making connections, changing modes, turning the transmit back to the other station, etc. But—a good operating mouse is useful.

XPWare comes with automatic formatting for the various modes to do such things as call "CQ." If you take a look at the screen shot (**Photo A**), the CQ sequence was the result of a mouse click (you can substitute F5) on the CQ button in the tool bar. If there is no linkup, the program causes a 45-second receive time and then repeats the CQ sequence. This is set for five complete cycles and you can stop it at any time. All this was ready to go as soon as the program was up and running—nothing to read, no codes to insert, just sit down and play.

Somebody said recently that if a program isn't intuitive enough to be run using the help screens, it is just plain bad software. XPWare, therefore, qualifies as good software by that criterion.

I happen to enjoy PACTOR, so that is most of what I have done since it came up running a few days ago, but I see that just about everything that applies to one mode goes for the others. I noticed, to my surprise, that when I connected to the local packet node, a sweet feminine voice came on and not only told me that I was connected, but also gave the callsign in phonetics. The same thing occurs with a PACTOR link.

Is the comm port problem resolved?

Possibly the strangest thing in all this is that which I have been told is impossible has occurred. Remember how the comm 2 and comm 4 cannot have the same IRQ and be opened at the same time? Well, these two ports have IRQ 3 like they are supposed to, and I can have comm 2 opened with XPWare, and connect to the phone line with my modem on comm 4! Honest. No tricks involved. Don't ask me to duplicate the magic. The wife has told me all along there is a strange virus in this room. I think I will have to join her method of reasoning. It is about as logical as anything that has happened during the past week in this little room where I escape from the realities of life.

If you have questions or comments about this column, E-mail me at [jheller@sierra.net] and/or CompuServe [72130.1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line at [KB7NO@N7NPB.#NONEV.NV.USA.NOAM]. For now, 73, Jack KB7NO.

Number 72 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the October issue, we should receive it by July 31. Provide a clear, concise summary of the essential details about your Special Event.

JULY 4

DILLSBURG, PA The Harrisburg ARC will hold its Firecracker Hamfest 8 a.m.–2 p.m. at the Monagahan Fire Hall, 245 W. Siddonsburg Rd., Dillsburg PA. VE exams start at 9 a.m. Talk-in on 146.16/.76 MHz. For info and table reservations *phone the HRAC AnswerLine at (717) 232-6087.*

JULY 5

MILTON, ONTARIO, CANADA The 23rd Annual Ontario Hamfest® will be sponsored by the Burlington ARC, at Milton Fairgrounds. Gates open 7 a.m. to commercial vendors (Robert St. gate only), 8 a.m. to tailgaters (Robert St. gate only), and 9 a.m. to the public (Thomas St. gate only). Adm: $5 per person; tailgate parking $2 per vehicle. The CLARA Annual Picnic Meeting starts at 11:30 a.m. Weekend camping $10 per site. Talk-in on VE3RSB 147.21 and simplex 146.52. Contact *Burlington ARC, P.O. Box 85037, Burlington Ontario L7R 4K3 Canada; or [ww.bigwave.ca/~jefdavis/barc/]. Or contact Jeff VE3COJ, (905) 335-4862; E-mail: [jefdavis@bigwave.ca].*

SALISBURY, NC The North Carolina Alligators Group "Firecracker Hamfest" will be held at the Salisbury Civic Center, 8 a.m.–1 p.m. Admission is $3 in advance (with an SASE), or $4 at the door. Free to XYLs. Auction of goods will be at 1 p.m. Dealer setup at 6 a.m. Tables in the air-conditioned center are $5. Outside flea market spaces are free. Contact *Walter (Alligator) Bastow N4KVF, 3045 High Rock Rd., Gold Hill NC 28071.* Talk-in on 146.625. Directions: From I-85, take Hwy. #52 West/East Innes St., turn left on South Boundary St. The hamfest is on the left.

JULY 10 & 24

FT. WORTH, TX The Lockheed ARC and the Kilocycle Club of Ft. Worth TX, will sponsor test sessions for all classes of licenses. They will be held at the Lockheed Recreation Area facility, 2400 Bryant Irvin Rd., starting at 7 p.m. G.R.O.L. testing by appointment only. For info call *Ted Richard AB5QU, (817) 293-6745.*

JULY 12

OAK CREEK, WI The South Milwaukee ARC, Inc., will hold its 28th annual "Swapfest" on Sat., July 12th, at the American Legion Post #434 grounds, 9327 S. Shepard Ave., 7 a.m. until at least 2 p.m. CDT. Free parking, picnic area, and free overnight camping are available. Admission, $5 per person includes "Happy Time" with free

Continued on page 78

Number 74 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

I don't know what's more striking to me, that this column now begins its twenty-first year, or that my son, born the year I started this column, will soon mark the same milestone. And I'm not that old, even though I qualified for the QCWA almost ten years ago!

Through it all, as I have said countless times, it has been you, the readership of *73 Magazine* and this column, who have taken me through good times and bad. It is through you, and with your help, that I am able to maintain the breadth of material in RTTY Loop, covering everything from greasy old Model 15s to the latest Windows 95-based digital programs. Those of you who have been reading these pages for a while know that it was in this column that many of you first saw the Epson MX-80 printer, one of the first dot matrix printers to hit the consumer market, as well as tales of 6800, 6502, and 6809 microprocessors back in the eight-bit days.

Well, with that bit of nostalgia, let's see what readers of mid-1997 are discussing. Paul Cecil KA5FPT/DA2PC, in Kaiserslautern, Germany, the largest US military community outside the United States, offers his comment about the Pakratt program. He says that he, too, has the PK-232MBX and Pakratt II 5.5, with PACTOR. But, looking over everything, he realized that, "It is actually calling up a separate program. All that the 5.5 upgrade did was to add PACTOR to the menu, among some other things. I hope that this answers some questions."

Thanks, Paul. I receive a variety of questions on the various programs, and its always good to hear one ham's experience.

With a problem solved, comes a problem presented. Doug VE6IT passes along this problem:

"I inherited a DRSI HF modem and the VHF packet adapter. However, no documentation came with either unit. I was wondering if you knew anything about these units, including connections and software I could use to put them in service. I regularly read your articles and find them great."

Doug, I have less than you—at least you have the unit! Will pass it along, though, as you never know what someone might have in a basement drawer.

After those two meaningful letters, here's a lighter note, from Robert E. Pearson W9KKL, who flatters me with the following:

"Just a short note: I think I have read every word you have written in *73 Magazine*. I used to borrow a friend of mine's *73* from about 1973 to about 1976. They lowered the price about that time, and I started taking it, and have ever since. Back then I was really broke. Although I myself do not play RTTY now, I used to. The Internet sort of takes my time. I have a PK-232, HAL CT-2200, and an old Model 19.

"I really like your home page, the greeting, and everything. I have one comment, please add your picture and perhaps your rig to your home page."

With space on my server at a premium, I am sure that my fans would rather have a RTTY program to download than see my punim, but I'll give it some thought. That greeting Bob refers to, by the way, is a little clip of my voice welcoming you to the page. Check the address of the RTTY Loop Home Page below, and if you ve not checked it out recently, have a look. Thanks for the strokes, Bob, and I'll try to live up to it all!

Last month I detailed some of the problems faced by amateurs using AEA equipment, pending the restoration of commercial support. S. Neil Xenias N4CTB passes along the following bit of wisdom:

"I really enjoyed your column in the March issue. I, too, am saddened by what happened to AEA (you can guess which multimode controller I own!). I wanted to offer some help to your readers which may or may not be fruitful. Here in Virginia, many of the Army MARS members use the PACTOR mode to handle MARS traffic. A large percentage of these folks use the AEA PK-232.

"The MARS group here has a 'Technical Librarian' who maintains copies of technical manuals, equipment conversion info, and most recently, EPROM listings. If your reader(s) in need can hook up with a local MARS member in their town, chances are that they can get a set of EPROMS burned for them. 'Course, they'll probably get the recruitment pitch, but we need all the members we can get—HI!"

As a former member of a MARS program, quite active during the 1970s, I can vouch for the thoroughness of the system. For those not familiar with the Military Affiliate Radio System, this is a volunteer civilian organization which acts to support members of the armed forces throughout the world. During the Vietnam war, for example, I spent many nights and weekends handling message traffic between soldiers in the field and their families at home. So, if they can help you, don't be shy about looking into helping them. They can use you, and you'll feel good for doing it.

On the RTTY Loop Home Page, I have a program called A2FTerm, an Apple II RTTY program, with a request for comments. Since I get a fair number of requests for Apple RTTY programs, let me pass along what Paul N5YFK has to say about it:

"It is a workable Apple II program—in fact, considering the old 6502 computer chip and the instruction set, a very good program. (I started off programming in 6502 machine language for the Apple II.) A very nice feature is that it will run on a system with a single disk drive. It can be downloaded to a PC, and then transferred over to an Apple with some ease. If each computer (PC & Apple) has a modem, all you have to do is connect them with a phone cord, have one on standby (i.e., ATA in Hayes lingo) and just dial a single digit with the other. The one on standby will pick up the phone and you have communication between the two. Download the file from the PC to the Apple and save to disk. That's all. If you don't have them both at the same location, a local phone call will do.

"The only real problem with some Apple files is that they are compressed, and just plain unusable unless you have a big Apple system with a hard drive and that particular version (often obsolete, abandoned, and nowhere to be found) of the compression program. So support the Apple II, but in uncompressed programs—after all, they really are small by today's standards.

"I appreciate the program—as I have still have 3 working Apples, one of which I lend out to persons wanting to try packet along with an older MFJ TNC."

Thanks, Paul, for that look at an older, but still quite usable, program. I know that there are those who would like this program, which is on Disk #7 of the RTTY Loop Disk Collection, albeit on a PC-formatted disk.

From an older program to a newer one, Stan Huntting KFØIA, passes along the following notice about a program for Kantronics TNCs:

"As a computer-literate amateur radio operator, there's an excellent chance you're active on one or more of the 'digital' modes, and that you use Kantronics TNCs in that activity. Also, as an Internet-connected amateur radio operator, there's an equally good chance you use MS Windows and a fast computer. If so, you should know about KaWin—the performance-enhancing software designed especially for Kantronics TNCs and MS Windows. Visit the KaWin home page, at [http://www.mutadv.com/kawin] (Keyword to:) to learn more and to download the full KaWin system to try it on your own system.

"KaWin supports all TNC communication modes, including VHF and HF packet radio; CW, RTTY, ASCII and Navtex; Amtor, PACTOR, G-Tor, Tor-standby and G-Tor Monitor. Its Host mode interface means KaWin and your TNCs communicate computer-to-computer with full use of your

Ask Kaboom

Number 75 on your Feedback card

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More video recording

For the past several months, we've been exploring television: its history, signals and manipulation. I realize the topic of video recording isn't strictly ham-oriented, but video is, more and more, a part of the radio experience, and an understanding of it can only enhance your ham radio fun, especially if you're interested in SSTV or ATV.

Last month, we took a look at the first practical video recorder, the quadruplex VTR, designed for broadcast use. If you've ever been in the control room of a TV station, you've probably seen one of those behemoths. The high-pitched whine the headwheel makes is not easily forgotten! Quad VTRs were incredibly complicated, and, as I mentioned last time, never filtered down to the home-use level.

A home video recorder was the "holy grail" of the electronics industry for a good twenty years. Anyone with some foresight knew such a product would be a smash hit, perhaps as big as television itself, and everyone wanted to be lead dog in that race—so why did it take so long to finally happen?

Not easy

As we explored last time, there were many obstacles to recording a video signal, at any price level. And certainly, no home user could afford a tape recorder that cost more than his house! Was there any way to make an affordable home video recorder? Until about 1970, the answer seemed to be "no." Many companies tried all kinds of ways to bring the cost of video recording down, giving up, one by one, as they encountered technical hurdles that couldn't be solved at the price levels necessary for home use. RCA was a pioneer in this area, and spent millions of dollars researching the "HVTR," as they called it. Yet, the company finally announced, around 1972, as I recall, that "it just can't be done," and abandoned the project. Of course, it *was* done, slowly but surely. Here's how:

A different beast

In the early 1960s, Sony, Matsushita (Panasonic), Toshiba and other Japanese companies had begun to introduce non-broadcast-quality machines in the $2,000 range. At first, they were black-and-white only, as no one had yet solved the timing problems required for color recording. These machines used the "helical scan" principle. Like quad machines, they had spinning heads and employed FM recording. But that's where the similarity pretty much ended.

Quad machines used a very high head-to-tape speed of 1,500 inches per second, recorded on two-inch-wide tape, and laid down tracks which were nearly perpendicular to the tape travel. That resulted in a short track (no longer than the width of the tape), so it took several head sweeps to make one TV field. That required very tight servo control of the headwheel, so that the signal disruptions, inevitable as one head left the tape and the next one made contact, occurred in portions of the signal which were not visible on the screen! Even worse, the long-lasting but brittle ferrite material that would give long service life could not be used for the heads, because the sideways motion of the tape against the heads would break it—so quad heads wore out fast.

The helical concept, so named because the diagonal wrap of the tape around the head drum looks like a helix (if it wraps all the way around, which modern machines don't), had been tried by Ampex but discarded as unsuitable for broadcast use. For less critical applications, though, it had tremendous advantages, along with a few disadvantages. The diagonal wrap resulted in long, diagonal tracks on the tape, whose length was limited only by the circumference of the drum, rather than the tape width. Consequently, narrower tapes could be used, and one-inch, three-quarter-inch and one-half-inch machines were common. Plus, those long tracks meant that an entire TV field could be recorded in one head sweep, vastly simplifying the servo required to control the head motor, and easily keeping the signal disruption (called the "head switching point") out of the picture, near the vertical sync. Another great benefit was that, since the tape direction and direction of the head scan were at a fairly close angle, there was very little sideways stress on the heads, so ferrite could be used. Coupled with advances in tape manufacture that made for much smoother tapes, and a slower scanning speed (because broadcast-quality bandwidth wasn't needed), headwear was finally reasonable, even though the scanning speed was still over 300 inches per second. Now, expensive video heads could last for thousands of hours, rather than hundreds.

This sounds like such a great system—why couldn't the broadcast machines use it? Unfortunately, it had some serious disadvantages as well. The first was that, in order to wrap the tape diagonally, it had to be pulled out of its normal plane of motion. You could do that, but it required some cone-shaped guides, and the tape motion wasn't terribly stable. Plus, the much larger mass of the head drum meant you couldn't servo-control it very fast, so ultra-tight edit timing, so necessary in the broadcast world, wasn't possible. But perhaps the biggest disadvantage to helical scanning was its generally poor timebase stability. In other words, the timing of the signal wobbled too much for broadcast use. By law, broadcasters must meet some very strict signal standards, and no helical machine could even approach them. Wobbly timing means wobbly pictures, and that just wasn't tolerable in a TV station.

In non-broadcast applications, though, some timebase error could easily be tolerated. Helical machines were quickly accepted in educational and corporate markets. Institutions and businesses could afford to spend a few thousand dollars on TV equipment, and that market opened the gate for development of the home video recorder. The race was on!

More obstacles

So, if machines could be made to sell for $2,000, why not just make lots of them, so that the economy of mass production would bring the cost down? After all, we see that today in many initially expensive products, like computers. Alas, video recorders are fundamentally different from most other high-tech products: they're intensely mechanical, rather than mostly electronic. It's easy to mass-produce circuit boards, but not highly precise mechanical assemblies. Video

---

dual-port TNCs and simultaneous multiple TNCs, multiple ports, multiple streams and multiple radios.

"KaWin is a native MS Windows program with a no-compromise design for 486 and Pentium systems. Looks like, feels like and talks to your other Windows applications with fully event-driven communications. Intuitive menus, full mouse support and on-line help make KaWin is easy to learn. Quick keys, Quick connects, Brag files, CQ robot, restartable binary file transfers, ANSI graphics and much more."

This is a nice program, which can be downloaded in a "try before you buy" arrangement. Thanks to Stan for passing along the information.

Check out the RTTY Loop Home Page for all that I mentioned above, and more stuff as well, at [http://www2.ari.net/ajr/rtty/]. Let me hear from you by snailmail at the post office box address above, or by E-mail at [ajr@ari.net], on America Online at [Marc WA3AJR], or on CompuServe via the new address, [Leavey@compuserve.com]. Next month, more on new RTTY programs, old RTTY pictures, and crazy RTTY users.

Number 76 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041-0099
[carrjj@aol.com]

Safety first: some antenna erection guidelines

One reader once wrote and took me to task for saying too much about safety. He claimed that interest in safety is minimal, and that everything regarding safety is (his words) "intuitively obvious to even brain-dead idiots." I most respectfully disagree. Safety is not a "given," especially where antennas are concerned.

Antennas are inherently dangerous to erect if certain precautions are not followed. It's impossible to foresee *all* the situations that you might face in erecting an antenna. I would like to give you all possible warnings, but that isn't possible. You're on your own, and must take your own responsibility when installing an antenna. I can, however, give you some general safety guidelines. Knowledge of what you face, some hard-nosed sound judgment, modulated by common sense, are the best tools on any antenna job.

One rule that is an absolute is that no antenna should ever be erected where the antenna, the feedline or any part thereof crosses over a power line. EVER! This is a "no kidder"—don't do it! Power lines look insulated, but there are often small breaks or weakened spots (especially a couple days or more after installation) that can bring the antenna into contact—lethal contact—with the hot power line. Every year or so we hear about an SWL, scanner/monitor buff or ham radio operator being killed by tossing an antenna wire over a power line. Avoid making yourself into a high power resistor!

The same rule applies to situations where the antenna can fall onto a power line if it falls down or breaks. You have to examine the situation with a critical eye to see if there is any possible way for that antenna, or its support structure, to fall onto a power line if it breaks in any way whatsoever. On my lot in Virginia I have a 23-foot mast erected on the back of the house. When I installed it I made a scale drawing of the back yard showing the path of the power line. The 23-foot fall radius of the antenna was plotted for several possible antenna locations. It should not intersect either the power lines or the cable TV line when it falls. It should also not be in a position to fall over a pedestrian path, a place where children play, or across a public walkway or street (lawsuits are messy). Or as one chap found out the hard way, it should not be in a position to fall through a window!

Another caution is that you should be physically fit to do the work. While the on-the-ground portion of the work is not usually too strenuous, any climbing at all, even on ladders, can be taxing for some people. Antenna materials are deceptively lightweight on the ground, but when you get up on even a small ladder, they are remarkably difficult to handle. Attempting to manhandle a 22-foot vertical once wiped my back out, and I consider myself fortunate that the pain hit me after I'd dismounted the ladder. Besides, if you could see me, you would wonder why a man my size was on any ladder in the first place. Before using a ladder, learn *how* to use a ladder. A lot of homeowners, whether putting up antennas or painting the upstairs windows, fall off ladders that were being used incorrectly.

If the wind blows even a few miles per hour, the danger is magnified considerably. I recall a friend—who is a large, strong bear of a man—attempting to install a 26-element television "all channel" antenna on the roof of his two-story house. The antenna was easily handled with one hand on the ground and with no wind blowing, but up on the roof it was a different story. He was on the peak of the roof, when a gust of wind came up suddenly and caught the antenna. It acted like a hang glider, and pulled him off the roof, plunging down two stories to the patio below; he fractured his pelvis and busted a leg. Expensive TV antenna, I reckon. *Be careful.*

One good rule is to always work under the buddy system. Ask as many friends as are needed to do the job safely, and always have at least one assistant even when you think you can do it alone. Erecting a large antenna—and some small ones—without help is just plain stupid. At least have someone around who can call 911 if you mess up.

Always use quality materials and use good work practices. Antennas, being potentially dangerous, should always have the best of both goods and workmanship in order to keep quality high. It is not just the electrical or radio reception workings that are important, but also the ability to stay up in the air and safe.

When planning the antenna job, keep in mind that pedestrian traffic in your yard could possibly affect the antenna system. Wires are difficult to see, and if an antenna wire is low enough to intersect with someone's body, then it is possible to cause serious injury to passersby. Saboteurs and the Resistance used to knock Nazi motorcyclists off their bikes (and to their doom) using a bit of wire stretched across the road. Even when the person is a trespasser, the courts may hold you liable for injuries caused by an inappropriately designed and installed antenna. Take care for safety, not only for yourself, but for others.

One necessary reminder is that

---

heads had to be positioned on the drum by hand, under a microscope, to a tolerance of a couple of microns, in all three dimensions—and the roundness of the drum itself had to be within about five microns, or interchange of tapes between machines would be unusable. Also, by the time serious development was underway, there was one very tricky requirement that industry was willing to do without, but home users never would: color. Although the technical issue had been solved by the early 1970s, and color machines were available to industry, the cost of color recording was still too high for home use. Worst of all, the industrial machines still consumed too much tape per hour of programming, and manufacturing videotape wasn't cheap.

Although today we take $2 videocassettes for granted, it wasn't always like that! Not so long ago, those same tapes were $18. Reel-to-reel videotape cost about $25 per hour in the 1970s, and that was when money was worth much more. The cost per hour of tape was, perhaps, the biggest obstacle of them all.

Here it comes

In an effort to reduce tape consumption, various schemes were tried. One that actually appeared in some industrial machines was to record only every other field of the TV signal, and play the same field back twice. Called "skip field" recording, it reduced tape consumption by 50%, but it resulted in a loss of vertical detail of the picture by the same amount. Worse, it often caused jumpy, jittery pictures. Sony's CV-2000 and other mid-1960s machines used the technique, but it was no real solution.

Eventually, a Japanese standard called EIAJ (Electronics Industry Association of Japan) was agreed upon. This format used half-inch tape at seven and a half inches per second, and recorded all the fields. Tapes made on an EIAJ machine could be played on any other, regardless of manufacturer. EIAJ units were very popular in universities and early cable TV channels. Eventually, an EIAJ-2 format was created for color recording, but it was soon eclipsed by a great advance in helical technology which drastically reduced tape consumption, thereby beginning the onslaught of the home video formats. At last, true home video recording was coming.

Next time, we'll explore the modern VCR: how it came to be, how it works, the sweeping effect its creation has had on the manufacturing and development of other products, and why it's so cheap today. The grail is just around the corner...

Until next month, 73 de KB1UM.

your local government might have some interesting ideas—legal requirements actually—concerning your antenna installation. The electrical, mechanical and zoning codes must be observed. There is a great deal of similarity between local codes because most of them are adaptations from certain national standards. But there are enough differences that one needs to consult local authorities. Indeed, you may need a license or building permit to install the antenna in the first place.

One problem that SWLs and scanner monitors face is that their antennas are not protected by the FCC as are ham antennas (local governments have limited rights to regulate ham antennas; only "reasonable" mechanical and electrical standards can be imposed), so it may be illegal for you to install *any* antenna. About 30 years ago a friend of mine in a radio club found out that his county had an ordinance that said an outdoor antenna must be double its own height plus fifty feet from the nearest property line. He received a summons after a complaint from a neighbor. In a county full of quarter-acre home lots, however, that was a ridiculous law. Very few outdoor TV antennas met that strict requirement! So Hal went to the court house and asked for 50,000 complaint forms. Using a local county directory, he proceeded to file the same complaint as he'd received against every homeowner in the area. The county board repealed the law during the next meeting.

Save all paperwork regarding your building permit, including inspection decals or papers, and the original drawings (with the local building inspector's stamps). If a casualty occurs, then your insurance company may elect not to pay off if you have violated an electrical, mechanical, building or zoning code. That clause may be overlooked by an enthusiastic antenna builder, but it could prove to be a costly oversight.

If you think this commonsense information is "too much" about antenna safety, then I will certainly be praying for you. Please be careful...you people are my friends and I don't like to see friends get hurt.

New books

Over the years a number of readers have honored me by buying my books, and for those supporters I am deeply grateful. I have recently signed to do a line of several books called the *Electronic Circuits Guidebooks*. The first one, which is on sensors and sensor interfacing, should be out about the time this article is published. The publisher is Howard W. Sams & Company/PROMPT Publishing (2647 Waterfront Parkway East Drive, Indianapolis IN 46214-2041). If you enjoyed the electronics books once published by the old Sams, and by TAB Books when they were still in Blue Ridge Summit PA, then you might want to check out the new Howard W. Sams catalog.

Those of you who have enjoyed my articles on radio and science may be interested in a new book I've just signed for with Sams on RadioScience Observing (a term I coined for all forms of scientific observation using radio receivers, including whistler hunting, radio astronomy, Jovian radio signals, radio propagation, solar eclipse observations and so forth). I am just starting to write it, so look for it early next year.

If you have any ideas to share for the radioscience book, especially if you teach science, then I would very much appreciate hearing from you. I also would enjoy receiving suggestions of any kind for this column.

Continued from page 72

refreshments. Free flyer by writing to *The South Milwaukee ARC, Inc., P.O. Box 102, South Milwaukee WI 53172-0102. Tel. (414) 762-3235.* Talk-in will be on 146.52 (WA9TXE) simplex as well as on many of the local repeaters.

PETOSKEY, MI The Straits Area ARC will host a Swap & Shop in the 4-H Bldg. at the Emmet County Fairgrounds. Talk-in on 146.68(-) and 146.52. Contact *Jim KC8FFS at (616) 537-2422* for details. For VE exam info, call *Floyd KG8CS at (616) 526-5503.*

JULY 12-13

INDIANAPOLIS, IN The Indianapolis Hamfest will host the ARRL Central Division Convention as well as feature a huge ham, computer, and electronics show. Marion County Fairgrounds, easy access from I-465 and I-74. Commercial exhibits, flea markets, forums, banquet, overnight camping available, home-brew contest, T-hunts, prizes, more. Write or call *Indianapolis Hamfest Association, P.O. Box 88677, Indianapolis IN 46208; tel. (317) 251-4407; [www.indyhamfest.com].*

JULY 13

KIMBERTON, PA The Mid-Atlantic ARC will sponsor an indoor/outdoor hamfest at Kimberton Fire Company Fair Grounds, Rte. 113, south of the Intersection with Rte. 23., starting at 7 a.m. Tables, 1–4, $10 ea.; 5 or more, $8 ea., not including admission. Tailgating, $5. Adm. $5. Talk-in on 146.835(-) and 443.80+ PL 131.8. Contact *Bob Haase W3SA, (610) 293-1919; FAX (610) 293-7688; E-mail: [wb3joe@voicenet.com], or write to MARC, P.O. Box 352, Villanova PA 19085.*

PITTSBURGH, PA The North Hills ARC will hold their 12th annual hamfest 8 a.m.–3 p.m. at Northland Public Library, 300 Cumberland Rd. Talk-in and check-ins will be on 149.09 W3EXW, the North Hills ARC rptr. Free admission, free parking. One free automobile-sized space per tailgater; each additional space $5. The hamfest is handicap/wheelchair accessible. Contact *Bob Ferrey, Jr. N3DOK at (412) 367-2393; or via E-mail at [bferrey@nauticom.net], or through the North Hills ARC Web site at [http://nharc.pgh.pa.us].*

SUGAR GROVE, IL The Fox River Radio League annual hamfest will be held at Waubonsee Community College, Rte. 47 at Harter Rd., Sugar Grove IL. Flea Market setup Sat. at 7 p.m., Sun. 6 a.m.–8 a.m. Doors open Sun. at 8 a.m. VE Exams 10 a.m. Bring original license, copy of license and photo ID. Talk-In on 147.210(+) (PL 103.5/107.2). Contact *Diana Skube WD9API, c/o FRRL, P.O. Box 673, Batavia IL 60510. Tel. (630) 293-7485.*

JULY 19

NEWPORT, NH Sugar River Amateur Radio Festival and Flea Market will be held on the Newport Common Saturday, 8 a.m.-3 p.m. Food, tailgaters, special event station, ham radio demos, vendors, RC model helicopter demos, prizes, VE test session, flea market, more. Overnight camping Friday. Exit 8 off I91 (12 mi. east) or Exit 12 off I89 (8 mi. west) to Town Common in Newport. Talk-in on 146.76 rptr/146.52 simplex. Adm. $6 tailgaters, $10 fleamarketers, buyers FREE. Pre-registration encouraged. Contact: *Rob Boyd N1CIR, 648 Rt. 103, Sunapee NH 03782-3719; phone (603) 863-5383. Packet: N1CIR@WA1WOK.NH.*

JULY 20

AUGUSTA, NJ The Sussex County ARC's 19th Annual Hamfest will be held at the Sussex County Fairgrounds, Plains Rd., beginning at 8 a.m. Reg. is $5 per person, YL and harmonics free. Limited indoor table space $13 per table; outdoor space $10 per vender. Talk-in on 147.300 and 224.50 rptrs., and 146.52 simplex. For advance sales and info, contact *Daniel Carter N2ERH, 8 Carter Lane, Branchville NJ 07826. Tel. (201) 948-6999.*

BRUNSWICK, MD "SweatFest '97" will be held rain or shine by the Mid Atlantic DX and Repeater Assn., at the MARC Train Station. Seminars, flea market, demonstrations, commercial vendors, and an ARRL test session will be featured. Contact MADRA Sweatfest '97, 230 N. Potomac St., Suite #2B, Hagerstown MD 21740. VE exams will begin promptly at 9 a.m. (be there at 8:30 a.m.). E-mail to *[madraclub@AOL.COM]*, or *[http://members.aol.com/madraclub]*. Talk-in on 147.06 and 448.125.

CAMBRIDGE, MA The MIT Electronics Research Soc., the MIT Radio Soc., and the Harvard Wireless Club will hold a tailgate electronics, computer and amateur radio Flea Market Sun., July 20th, 9 a.m.–2 p.m. at Albany and Main St., Cambridge MA. Admission $4. Sellers $10 per space at the gate, $9 in advance (includes 1 adm.). Setup at 7 a.m. For space reservations and info, call *(617) 253-3776.* Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT. BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725, PL2A W1XM rptr.

VAN WERT, OH The Van Wert ARC will hold their 10th annual hamfest at Van Wert County Fairgrounds, US 127 south, 8 a.m.–3 p.m. Free parking. Overnight $10. Adm. $4. Pre-reg. for VE exams.; send SASE to *Bob High KA8IAF, 12838 Tomlinson Rd., Rockford OH 45882,* or call *(419) 795-5763.* Tables $10 (8 ft.). For table reservations, send SASE to *VWARC, P.O. Box 602, Van Wert OH 45891-0602. Tel. after 5 p.m., Bob WD8LPY, (419) 238-1877. E-mail to [barnesrl@bright.net] or [http://www.bright.net/~barnesrl/w8fy.htm].* Talk-in on 146.850/.250.

JULY 25 & 26

OKLAHOMA CITY, OK The Central Oklahoma Radio Amateurs will sponsor their 24th annual "Ham Holidays '97" at the Oklahoma State Fair Park (Hobbies, Arts & Crafts Bldg.), northeast of the I-40 and I-44 intersection. Doors open 5 a.m.–8 p.m. Fri., July 25th and 8 a.m.–5 p.m. Sat., July 26th. Technical and non-technical programs, fox hunt, VE exams and flea market. Pre-reg. $7, $9 at the door. Flea market tables are $10 ea. in advance, $15 ea. at the door (if available). Talk-in on 146.82. Additional info and reg. forms are available on the CORA Web site at *[www.geocities.com/heartland/7332]. Address other inquiries to Ham Holidays '97, P.O. 95942, Oklahoma City OK 73143; or E-mail [n1lpn@swbell.net].*

JULY 26

NEAR WAYNESVILLE, NC The Western Carolina ARS of Asheville NC will hold its 22nd annual hamfest 8 a.m.–4 p.m. at the Haywood County (NC) Fairgrounds. Exit 24 off Interstate 40, then south on Hwy 209 3 mi. New and used radio gear, flea market, tailgating. Adm. $4 advance, $5 at the gate. Free parking. VE exams at 2 p.m. For info, contact *Norman Harrill N4NH at (704) 253-1192. For dealer and flea market info, contact Dan Henderson N1ND at (704) 684-6339. For tickets, contact Bob Helton KS4FX, P.O. Box 1488, Asheville NC 28802. For general info, call Tommy Queen K4BNP, (704) 258-2639. Talk-in on 146.91/.76.*

JULY 27

BALTIMORE, MD The Baltimore Radio Amateur Television Soc. will sponsor the Maryland Hamfest and Computer Fest at the Timonium Fairgrounds, York Rd. off I-695, I-83. Accessible to the handicapped. Kids under 12 admitted free, adults $5. Tailgating spaces $7 each, first-come, first served. Check in for free VE exams at 8:30 a.m.. pre-reg. required: call *John Creek WB3GXW after 6 p.m. at (301) 572-5124. For info and table reservations, write BRATS/P.O. Box 5915, Baltimore MD 21282. Tel. (410) 467-4634 voice or FAX. Web site [http://www.smart.net/-brats] or E-mail [brats@amart.net].*

RACINE, WI The Racine Megacycle Club will sponsor its annual Swapfest on Sun., July 27th, at the South Hills Country Club on the I-94 east frontage road between Hwy. 20 and Cty. Rd. K. Dealer setup at 6 a.m. Public access 8 a.m.–2 p.m. Talk-in on 147.87/.27. Indoor air-conditioned space at $8 per table. Tailgate space is available. Adm. $5 at the door, $4 plus SASE advance to *Racine Megacycle Club, P.O. Box 3, Racine WI 53401.* Forums, dealers, exhibits, demos, VE exams. Contact *Dave Voss WB9USI, (414) 554-7565.*

AUG 2

HOUGHTON, MI The 1997 Upper Peninsular Amateur Radio Convention, better known as the U.P. Hamfest, will be held at the City of Houghton's Dee Stadium facility, located on the downtown waterfront. Doors open to the public at 9 a.m. EDT. Vendors and persons selling equipment will have main floor access beginning at 7 a.m. EDT. Friday eve. access will also be available, although overnight storage will be at owners' risk. AC power by previous arrangement only. Tables are $6/full table, $4/half table. Contact *Roland Burgan KB8XI, (906) 482-2403; E-mail [rburgan@up.net], Packet: [KB8XI@W8YY.#UPMI.MI.US.NA]. For lodging/camping/boating info, contact Keweenaw Chamber of Commerce at 1-800-338-7982, or on the Web at [http://www.portup.com/mainstr/chamber/home.html].*

AUG 2 & 3

JACKSONVILLE, FL The 1997 ARRL National Convention will be held at the Osborn Convention Center in Jacksonville. Open to the public Sat. 9 a.m.–5 p.m.; Sun. 9 a.m.–3 p.m. The Greater Jacksonville Amateur Radio & Computer Show will host the event. Free parking in the main convention center parking lot. Setup 1 p.m.–6 p.m. Fri., Aug. 1st. Upgrade VE exams will be offered at 9 a.m. on Sun. at the convention site. A wide variety of programs and forums will be presented by ARRL staff and noted authorities of national stature. Banquet at 7 p.m. Sat. at the HQ hotel, the Jacksonville OMNI. A special rate of $69 per night is available to those mentioning the convention. Phone *(904) 355-6664 or 1-800-843-6664* for reservations. Reg. for the entire weekend is only $8, which includes parking in the main lot. For more info, visit the Web site at *[http://users.southeast.net/~jrmoore/hamfest.html]*, or *write Greater Jacksonville Hamfest Assn., P.O. Box 27033, Jacksonville FL 32205. For swap table reservations, contact Karl Hassler N4DHG, 2767 Scott Circle, Jacksonville FL 32223,* or *phone (904) 268-2302. Tables are $25 ea. for the weekend. For commercial exhibitor space, contact Vern Ferris KB4VPU, 356 Aries Dr., Orange Park FL 32073. Tel. (904) 272-7250.*

AUG 3

MARSHFIELD, WI The Marshfield Area ARS will host their 6th annual Potluck Picnic and Swapfest at Wildwood Park, Marshfield WI, starting around 11 a.m. All are welcome. Talk-in on 147.180. Contact *Guy A. Boucher KF9XX, 107 West Third St., Marshfield WI 54449. Tel. (715) 384-4323. Packet: [KF9XX@W9IHW.WI.USA.NA]. E-mail: [guyboucher@tznet.com].*

PEOTONE, IL The 63rd Annual Hamfesters Hamfest will be held 6 a.m.–3 p.m. at the Will County Fairgrounds (I-57 exit 327 East) in Peotone. Sat. setup 3 p.m.–11 p.m. Free overnight parking. Secured building. Main exhibition hall opens at 8 a.m. Flea Market electric hookup fee is $10. Electricity will cost $10 for 4 tables or less; electricity is free for more than 4 tables. One free ticket per vendor, all others, $4 in advance, $5 at the gate. For reservations, etc., contact *Dave Brasel NF9N, 6933 W. 110th St., Worth IL 60482.*

AUG 9

BARABOO, WI The 1st annual Circus City Swapfest will be held at the Sauk County Fairgrounds 7 a.m.–noon, rain or shine. Tailgate sales. Free parking. Admission $5 at the gate, $4 in advance. Tables $5 for 8 ft. (includes one admission) Electr. available. For advance tickets and tables, contact *Yellow Thunder ARC, 1120 City View Rd., Baraboo WI 53913. Check the Web site at [http://www.thelorax.com/~sschulze/hamfest.htm].*

AUG 16

ROANOKE, VA A hamfest/Computer Show will be held by the Roanoke Valley ARC, Sat., Aug. 16th, 9 a.m.–5 p.m. at the Exhibit Hall, Roanoke Civic Center, Roanoke VA. Setup at 6 a.m. with help available. Features include equip. dealers, free forums, two walk-in VEC exam sessions, and an indoor/outdoor flea market. Adm. is $5 at the door or in advance, outdoor tailgating $5, Indoor flea market tables $10 per table, dealer tables $20 ea. (plus $20 for electr.). Make checks payable to, and mail an SASE to *RVARC, P.O. Box 2002, Roanoke VA 24009.* Dealers and inside flea market contact *Claude KE4UVO, (540) 774-8971, or [ke4uvo@intrlink.com].* All others contact *Terry AE4EW, (540) 890-6782 or [ae4ew@ix.netcom.com].* Talk-in on 146.985(-).

SPECIAL EVENT STATIONS

JULY 3, 4, & 5

NEAR ROSWELL, NM An Amateur Radio Special Event Station will operate 1700 UTC–2400 UTC, daily, July 3rd, 4th, and 5th, to celebrate the 50th anniversary of the "Crash at Corona" near Roswell NM. Freq.: Approximately 20kHz up from the bottom edge of the General HF band edge, 6–40 meters (phone and SSB), and in the Novice/Technician (CW) HF section of 15 and 40 meters. Listen for W5BI, WB5LYJ, NA5N and WA5WHN. The station will operate overlooking one of the debris fields near Corona NM. SWL reports are encouraged too. SASE required. Send a 9" x 12" SASE and 2 units of US first class postage, along with your QSL card to *Jay Miller WA5WHN, P.O. Box 6552, Albuquerque NM 87197-6552 USA. Check the W5BI Web page for further developments, [http://www.flash.net/~w5bi/], or contact via the Internet, [wa5whn@juno.com].*

JULY 7–13

AUSTIN, TX Amateur radio operators affiliated with the American Assn. for Nude Recreation, the Naturist Soc., and the Federation of Canadian Naturists, will observe the 22nd annual North American Nude Awareness Celebration during the week of July 7th–13th. Special event stations will operate from naturist resorts throughout North America on the following frequencies: 7.265, 14.265, 21.365 and 28.465 ± QRM. For a personalized certificate, please send QSL and 9" x 12" SASE to *Bob Redoutey N5KF, P.O. Box 200812, Austin TX 78720-0812 USA.*

JULY 11–12

PORTAGE DES SIOUX, MO The St. Charles County ARES will operate KGØYJ, 2300Z July 11th–1700Z July 12th, during their annual field activation. Freq.: 3.870, 7.270, 14.270 and 28.370MHz. For a certificate, send QSL and a 9" x 12" QSL and SASE to *Bill Bird KGØYJ, 144 Ridgecrest Dr., Chesterfield MO 63017-2653 USA.*

JULY 19

SISTERVILLE, WV Tyler County Amateur Radio Organization will operate KC8GXI to commemorate the last working sternwheel ferry on the Ohio River. Operation will be 1400Z–2200Z. Freq.: 3.860, 7.230, 14.260, and 28.360. For a certificate, send QSL and a 9" x 12" SASE to *TCARO, P.O. Box 287, Middlebourne WV 26149 USA.*

JULY 19 & 20

STRATFORD, NY The Fulton County Dr. Mahlon Loomis Committee will operate W2ZZJ on July 19th and 20th to commemorate the 171st anniversary of the birth of Dr. Loomis, the American radio pioneer, who was born at Oppenheim NY on July 21st, 1826. Operation will be from 1300Z–2000Z on the General-class phone portion of 75, 40 and 20 meters, and on the Novice 10-meter phone band. Also, on area 2-meter FM rptrs. For a parchment certificate and extensive literature, send QSL, contact number, and a #10 SASE (55 cents) to *W2ZZJ, 5738 ST HWY 29A, Stratford NY 13470 USA.*

JULY 20

TOTTENHAM, ONTARIO, CANADA Members of the Central Ontario ARC will operate the "Radio On The Train" event for the 4th year in succession, 10 a.m.–4:30 p.m., EST (1400–2030 hours UTC). They will invite check-ins under the callsign VE3ZVT (the South Simcoe Railway Amateurs Station), and will be on 75 and 20 meters—frequency dependent upon current conditions—for HF, and for local traffic via rptr on 146.835(-) MHz, with 103.5 transmit subaudible tone. Operators checking in with the train can receive a memento QSL card of the event upon request. Club members operate from the caboose of the steam train at hourly intervals from Tottenham to Beeton.

JULY 27

NEWINGTON, CT The Meriden ARC, W1NRG, will operate CW and phone, from the W1AW station, 1400–1930 UTC, to celebrate its 50th Anniversary. Operation will be on the General portion of the 10-, 15-, and 20-meter bands and the Novice 10-meter subband. For a certificate, send QSL and a 9" x 12" SASE to *Meriden Amateur Radio Club, P.O. Box 583, Meriden CT 06450 USA.* 73

Number 80 on your Feedback card

On the Go

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

Effective communications

One of the most fascinating aspects of amateur radio is its variety. There is literally something for everybody, from traditional Morse code to satellite communications, from experimentation to chasing DX. This diversity, naturally, attracts different people for different reasons, leading to a wide variety of operating styles, techniques and attitudes. Perhaps the biggest differences are because some hams are attracted to the art of ham radio while others are attracted to its science.

The science of ham radio includes all the nuts and bolts: the different modes available, techniques for optimizing the utility of each mode and, of course, the all-important gadgets that go along with such pursuits. Those folks attracted to the science are most comfortable with a soldering iron in hand, or a computer manual in front of them as they try to improve performance of existing equipment or develop new methods. These folks may be likely to tweak the equipment and then get on the air for brief contacts so they can determine how well the new system is working. In some cases, it's name, QTH and signal report, and little else, then back to the drawing board (or out to the antenna farm) to figure out the next modification.

On the other hand, those more attracted to the art of the hobby tend to be more interested in communications. In some cases, the equipment is viewed as an appliance to be used rather than as something to be disassembled, reworked and put back together. These folks often enjoy such aspects as rag-chewing, networks, public service or disaster communications. Many new members of the ham radio community start off on two meters, and local communications is among their first encounters with the hobby.

Now most of us are a mixture of these two aspects of the hobby, enjoying both the technology and the interaction. It is rare to find any amateur who doesn't get sweaty palms when reading about a new high-tech accessory for the shack. However, some hams see the equipment as a means to an end rather than the end in itself. This month let's focus on the communication aspect of the hobby, particularly as it relates to public service or disaster communications.

"The ham community is just that—a group of people with a common interest."

The purpose of such communications is to convey a message which is accurate, timely and complete—most importantly, to ensure that the recipient gets the meaning that the sender needs to convey. This is difficult enough when we try to convey our own thoughts, but even more so when acting as a communicator for someone else. In order to be effective in such a situation, here are a few guidelines:

• First, most of communications is *listening*. As hams, we often love to talk (or type or work a telegraph key), but in passing message traffic, most of the time will be spent standing by. A SkyWarn event, for example, is often hindered by operators getting on the air to give "fair weather" reports. Likewise, during disaster communications, the frequencies become jammed as everyone tries to get himself heard. The communications challenge is to limit oneself to providing *only* the information that is requested.

• Second, make certain that your message is understandable. Speak clearly and slowly. Be brief. Finally, use language which will convey the message. Creative phonetics, such as "King Easy Eight Yellow Noodles," for example, will just confuse other operators. What about "Q" signals? Traditionally, the use of Q signals is discouraged except when using CW. Personally, I have no problem with spoken requests to "QSY" or acknowledging a message with "QSL." Use of this lingo is a natural evolution for any hobby, particularly a technical pursuit. If I want a language which doesn't change, I'll choose Latin. The key question is, does a word or phrase help get the message across? If so, it probably should be used; if not, avoid it.

• Third, think about what you need to say before you say it. If you are used to rag-chewing on the local repeater, communicating during an event or for a third party is more demanding. Exactly who is sending the message? Who is the expected recipient? Exactly what is the message? There is no harm in taking a minute before you press the push-to-talk switch to collect your thoughts. In some situations it may even be appropriate to take a moment to rehearse before transmitting. This is true in any area of communications. For example, many student pilots are taught to practice what they're going to say before contacting approach control or the tower. Sometimes this is very helpful and saves stammering once on the air.

"Creative phonetics will just confuse other operators."

• Fourth, if you are communicating as a part of a net, follow the net's rules and procedures. If a formal net has been called, every operator is normally expected to contact only net control. Once you are acknowledged, then it is okay to give your information. If you need to speak with another station, the procedure is often to request to "go direct" with that station. Net control will either give you permission to do so and have you stand by, or recommend another frequency where you and the other station can speak directly.

• Fifth, be supportive. The ham radio community is just that—a group of people with a common interest interacting with one another. If you need proof, listen in on the various repeaters in a given area. Each repeater tends to have its own personality, reflecting the interests and styles of the operators who regularly use that machine. As a member of a particular community it is our responsibility to help one another out. If someone (particularly a newcomer) makes an error in operating procedure, help out. It is the opposite of communications to criticize another ham, especially over the very public air waves where other hams and people with scanners can all hear.

Finally, as the old joke goes, "How do you get to Carnegie Hall?" "Practice! Practice! Practice!" Although most of us are pretty confident of our own abilities to be effective communicators, the time to find out is *not* when a storm or other disaster has hit. Check into a local Amateur Radio Emergency Service (ARES) or Radio Amateur Civil Emergency Service (RACES) net on at least a fairly regular basis. Volunteer to help out at the local 10k or fun run or a parade. The Red Cross may operate first aid stations at various events, and rely on hams for communication. At Louisiana State University, for example, hams provide this communication support during football games, as well as enjoy a bit of Tiger football in the bargain. This will help you develop the skills you'll need, and have some fun while you're practicing.

Communication is not only part of the hobby—it's an aspect that makes us most useful to others. The amateur operator and his or her communication skills is every bit as important as the equipment we use. Tweak your communications skills as carefully as you tune your equipment. It is the combination of both that makes us the most valuable. 73

Let's Keep CW Alive!

It's distinctive, it's useful, and—most of all—it's fun!

Arthur R. Lee WF6P
106 Western Ct.
Santa Cruz CA 95060

The skipper, Terry Parks N6NUN, pointed the bow of his 32-foot Grand Banks trawler toward Monterey and headed out into the cold, choppy water of the bay. Before going below for a hot cup of coffee, I asked him if he would put up his 15m whip antenna so that I could work a little CW. I enjoy being on the air when we are at sea and wanted to play around and make a contact or two. I sat down at the navigator's station, fired up the rig, tweaked the auto tuner a touch, and casually sent out a CQ. The feel of his key in the rolling sea was comfortable at about 12 words per minute so I stayed at that speed. To partially drown out the noise of the big diesel, I pressed the earphones closer to my head. After I tapped out only one call, a moderately readable station came back almost immediately. We chatted along, exchanging the usual information. My QTH, a maritime mobile in Monterey Bay CA; his QTH—*Romania!* I was so startled and delighted that I nearly spilled my coffee! After about 15 minutes, the band faded so we signed off. But we could never have made the contact on voice mode. Needless to say, Terry and I were pretty excited about the QSO.

Anyone for CW?

CW is a viable and useful language, something we hams can be proud of using. It's a great language, music to some, and a specialized communications skill that sets hams apart from the rest of the population. If we stop to consider, it is the common bond among amateurs that makes us a unique and truly distinctive group. At one time or another we all worked hard to develop our initial threshold speed of 5 wpm, yet a recent informal poll of a California amateur radio club disclosed that about half of the respondents rarely or never used CW.

As with any language, code must be practiced regularly to attain even the lowest degree of proficiency. One has to be comfortable with the mechanics of a language before enjoyment sets in and CW is no exception.

The Novice Enhancement Program opened up a portion of the 10 meter band to voice. This effectively short-circuited the past CW training period for Novices, allowing them to go straight to voice. This, then, can become a trap, just as attaining the Technician class license and acquiring 2m capability was for many hams over a multitude of many years in the past. As an enticement, and on the positive side, the major benefit of 10m voice privilege is that it gets many people on the air who might not be if forced to use CW. To some amateurs, CW is a painful experience and to be avoided at all costs. It doesn't have to be that way. In fact, CW can be (and is!) a lot of fun once it is mastered.

In many discussions with hams, there seem to be several basic reasons for not using CW. These generally are given as:

1. My code is rusty.
2. My code speed is too slow.
3. I don't know the proper procedures.
4. I don't know what to say.
5. I don't want my friends to know how bad I really am.

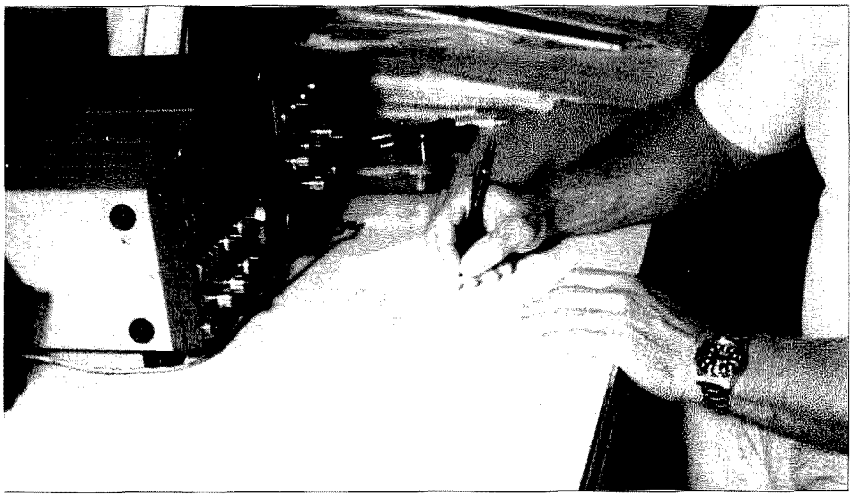


***Photo A.** Copying code off the air can get you back up to speed. Leave the rig tuned to a CW practice station as background music to get your mind used to hearing code.*

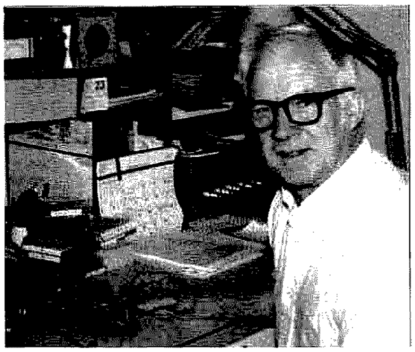


Photo B. The author, copying CW from W1AW code practice broadcasts. Send out a CQ on your own or return the call of someone who is sending at your speed of copy. Don't be in a rush. Slow copy is fine and gets you going again.

6. (Now get this one!) I can't spell.

These reasons are valid to those giving them, but they can be overcome with a little bit of effort. Reason number six is easy to get around. First of all, few of us can correctly spell every word we use in our daily conversations so why worry about it? Do your best, abbreviate when possible, and lastly, if this is any comfort, you can assume that the receiving operator won't mind a few misspellings. Offer a few "HI HIs" and let it go at that.

Things to do

Here are a few suggestions that might help increase your on-the-air proficiency and enjoyment of CW:

1. If you haven't been on the air with CW for awhile, a few minutes of off-the-air practice sending will shake out some of those cobwebs. Dust off the old key and code practice oscillator, relax, and send plain text out of the morning newspaper while having your morning coffee. Tape your sending for a later playback while on your way to work. Be sure to include a generous amount of mixed numbers. Telephone numbers in the classified section are a good place to start. Work in some callsigns from contest winner listings found in back issues of ham magazines.

2. After a few of these solo practice sessions to build up your confidence in getting those tough "L"s, "F"s, "G"s, and "W" sorted out again, turn on the receiver and copy some "easy-listening" code at *your* speed. Take it slowly at first, but don't spend more than 10 minutes at any one sitting.

3. Make a habit of turning the rig on to CW whenever you are in the shack. Use CW as background music and make no conscious attempt at copying—your subconscious mind will absorb the sounds of the characters by osmosis.

4. Work a CW contact by answering a CQ at your comfortable speed. Go ahead and answer—the sending operator, in most cases, won't bite you. Remember, he or she must want to talk to *someone* or they wouldn't be calling CQ in the first place! You can be that someone. This is a case where talking to strangers is encouraged. I tell my ham radio students that "Slow is good!" You don't have to be a speed demon to enjoy CW. Good, slow, code is a pleasure to listen to.

5. Make a commitment to yourself to work at least one CW contact within a given time period. Once or twice a week is fine to begin with. The object here is to use the skill in an established routine. The QSOs can be short, but fun contacts are inevitable.

6. Help a Novice. We were all Novices once. Get on the Novice band and work with someone who is struggling with the code for the first time. Help them overcome their fear of being self-conscious about their early efforts. Give them a few helpful tips if you can. Novices can benefit from your past operating experience. Remember, you have been in this hobby longer than they have.

7. Set up a CW sked with a friend. He or she could live down the street, across town, or thousands of miles away. You can help each other. When I first learned the code, I had the key in one hand and the telephone in the other, repeating back a string of numbers or callsigns my radio friend had just sent.

8. As your confidence with CW grows, push yourself a bit. Copy W1AW and some of the better code operators at speed higher than you think you can copy. Stretching is good exercise.

9. Take a chance. Contact someone who sends a bit faster than you can copy. Send a QRS if things get sticky. They will be glad to slow down if you only ask. After awhile, you will be pleasantly surprised that you can copy faster than you thought.

10. Initiate your own CQs. Grab the bull by the horns and go for it. You know what to do—you yourself have been trained by someone at one time or another. It is probably good to remember that you can do no wrong, a far as protocol goes. A CW friend once told me to pretend you are simply talking, only you are using your new language. About the only procedural rules you will have to observe will be to stay within the ham bands and to send your callsign at the proper times. Use the rag-chewer's tried-and-true guideline of just saying anything that comes into your mind!

As for voice communications, anyone can talk and most of us have been doing this since about age three. Household telephones and voice bands are excellent means of transferring information, yet, as hams, we must not overlook the bond that holds us together. We have that rare something that not everyone has—the ability to make ourselves understood in a unique way. CW is far from dead and can be richly rewarding if we work at it a bit. Give it a try—only through regular use can it be made easy. 73

Photo C. Bob Brouwer N6HLE, operating his ham rig aboard his 32-foot sloop, Cybele II. *Bob uses a straight key when at sea as a maritime mobile, but prefers his bug for shore use.*

Help for College-Bound Hams

Apply for an amateur radio scholarship.

Matt Minney N8PGI
Rt. 1 Box 126
Shock WV 26638

Students entering college are *always* interested in extra money. A ham radio operator has several options for finding college scholarships, and the opportunities are growing every year. If you qualify for one of these scholarships, you'll be one step closer to paying for your college education. The requirements for applying for a scholarship are generally not prohibitive and simply require filling out an application for review by committee.

What's available?

Amateur radio scholarships generally come from one of three sources: The ARRL Foundation, the Foundation for Amateur Radio, and Dayton Amateur Radio Association. All work in a similar manner, but each one has unique characteristics.

The Dayton Amateur Radio Association, the group that sponsors the Dayton Hamvention, offers several scholarships to students who graduate from high school in the year for which they are applying. These scholarships are about $2,000 per recipient.

The Foundation for Amateur Radio, located in College Park, MD, represents nearly two dozen organizations with diverse requirements and awards. The requirements vary for each scholarship, but several of these are available for every amateur. Some scholarships are available only to hams in a specific field or particular geographic area, such as a county or a state; in this case, being a graduating high-school senior is not required. The available amount begins around $500 and peaks at $2,000.

The last of the three major sources is the ARRL Foundation. This group is supported by the ARRL, and is based at ARRL Headquarters in Newington, CT. The ARRL Foundation also offers a variety of scholarships that have different requirements for eligibility. There are both general scholarships and those targeted to specific groups of hams. These again have geographic or academic restrictions. The scholarships available could again vary from $500 to $2,000.

What's involved?

Although each of the three major organizations has somewhat different rules and procedures, the processes are basically the same. There are usually about five general parts in most applications: a basic application, financial information, references, a transcript, and an essay, paragraph, or some other example of written material by the applicant. These may be part of the main application or separate forms, depending on the application.

"Work out your answers on a separate sheet of paper before you fill out the application."

Filling out the main application is the most important part of the process. This part of the process includes personal information. Questions that will appear include basics such as the person's name and the name of the institution that is being applied to. There are also questions about the applicant's academic career and standardized test scores. I suggest that the applicant work out the answers on a separate sheet of paper before filling out the application form. This will allow polishing any answers. Open-ended questions that ask why you and not someone else should receive the scholarship require serious thought.

A statement of the applicant's finances is a relevant question in scholarship applications. The best source to answer this question is last year's tax returns. The application will also want a projection of the need for the upcoming school year. Before giving a final figure include *any* realistic expenses that might be encountered, not just the tuition. Finally, some applications ask for information about other items such as special needs and real property such as cars. Be honest when answering these questions, but be careful to not provide answers that you believe the committee wants to hear.

The third component of an application for a scholarship is a set of references. Usually these references will come in two forms; one being for some aspect of the candidate's personality and one recommendation for a specific scholarship. The references for one's personality or character could entail as many as three different sources. Make every effort to include any information that will make it easier for the committee to locate your reference. It is a good idea to talk to your references ahead of time so they are prepared for the possible phone call. Secondly, some specific scholarships require a recommendation from a member of the sponsoring organization. Try to find a member in a local club or area net if there is no member of the organization in the area.

The fourth part of most scholarship applications is a transcript. There may not be a transcript requirement, but including one is a good idea. A high school student should ask the guidance counselor to provide a copy if needed. This will help to answer some questions about overall grade point average or test score questions.

The last major part of a scholarship application involves some sort of writing. This is a broad category that might range from a separate description of yourself to a paragraph that is the main application. This gives the scholarship committee some idea as to the applicant's writing ability and a hint about the

person behind the application. It is a good idea to include as much in the space as allowed, but make sure that the included material is something that the committee needs to know. Again, write as many drafts as needed on scratch paper, then present the best answer.

Helpful hints

A minor detail might not be the difference between receiving and not receiving a scholarship, but it is always good to generate as few problems as possible. Minor changes can make the application easier to read and more attractive to the committee.

A typed application is generally appreciated by most people, unless the applicant has excellent penmanship. There are two major benefits to typing the paper. First, it will be easier to read, and the second is that the application will appear much neater. Another simple hint is to finish the application as quickly as possible. This means asking for the references and transcripts ahead of time. This also gives the applicant time to make minor changes as needed. Writing out the answers to the application questions on a separate paper will make revisions much easier. Most applications require a copy of the applicant's amateur license, so be sure it is included.

Once the application is complete, make a last-minute checklist of all the elements that need to be included. Check the address and send it in several days before the due date. A late application may not be accepted. Scholarship winners will be notified by phone or by mail as to the specific scholarship and the amount. Winners may also be recognized by an amateur magazine or brochure. Instructions as to how to receive the scholarship will also be included in the notification. This usually involves sending the check to either the winner or to the institution listed on the application.

Any ham radio operator planning to continue his or her education beyond high school should consider applying for a scholarship. There are no guarantees of receiving any help with college expenses, but a well-done application is a definite step toward being the winning applicant.

I would like to acknowledge the use of each organization's scholarship materials in the creation of this article. I also wish to express gratitude for the help they gave to me in the completion of my college degree. ■

NEVER SAY DIE

Continued from page 31

outsource, there's a huge and growing need for the creation of new jobs.

The main problems facing entrepreneurs in starting new businesses (unless they've read my book, *Making Money, A Beginner's Guide*, and have followed my instructions) are getting funding and gaining the business skills needed for success. I have a sneaky proposal for helping to solve both of these problems.

The idea is to get a group of synergistic businesses together to form a support group. Almost all small businesses need support services such as lawyers, accountants, computers, office equipment and supplies, printing, advertising, maintenance, waste removal, telephones, insurance, office space, and so on.

Using the business expertise of such a supporting group, say as a board of directors, a new business can hardly fail. And since it doesn't cost a lot to get a new small business going, the startup funding could come from a fund put together by the supporting group. I'd call it a consortium, except for the negative connotations of "con," so let's call it a "pro"sortium.

Step two for the support group would be to get their state to set up a small business development administration to provide the needed funding—and to do this on a for-profit basis. I would ask the support prosortiums to indemnify the state for any losses. This would act as a filter to weed out questionable startups.

Clubbing Us

Proof that Wayne's basic guide to politics (Never Re-elect Anyone) works with your local ham club as well as a way to flush the Washington toilet you've allowed to back up arrives almost daily in letters from readers. Like how about the club president who has ordered that the club phone patch is for emergency assistance and not a substitute for a cellular phone? Sure, we do almost as well as CB when it comes to dealing with emergencies, but this is still a hobby and that means it's supposed to be fun. If the club repeater tends to get bogged down with club members making calls to their families, then put in another repeater. Good grief!

How much of an effort have your club officials made to bring in youngsters? Most of the clubs I've visited are almost all peopled with old men with one foot on a banana peel and the other already in the grave. There'll be lots of good deals on used ham gear soon. A few years ago I remember being amazed when I spotted a youngster wandering around at Dayton. Wow!

Mooned Again

A press release from the SETI League announced their collaboration with the Artemis Society with the goal of placing a radio telescope on the back side of the Moon. In order to buy into this project one has to be a pathological skeptic about both UFOs and contactees. Which, to my mind means that one has to be severely unread on the subject.

I often marvel at the blind spots many scientists have—at their inability to even investigate anomalies which to me are crying out for attention. Heck, I reported around 30 years ago in my editorial the results of my investigating a local crop circle. I interviewed the family living next to the field and heard about a UFO which silently hovered over their home for several minutes before going up and circling the nearby Crotched Mountain Rehabilitation Center, where it was seen by hundreds of people.

I do have to admit, as I've read the stories of contactees and talked with several personally, that I'm damned annoyed that I haven't been picked by the ETs for the experience. Perhaps they recognize that I'd keep them too busy answering my questions to be of much help.

Either a bunch of people, many with some impressive credentials, are secretly crazy, or the contactee experience is a reality. And that means that the aliens are not only here, but that they've been visiting us for a long, long time. I suspect our recent technology advances may have increased their interest, hence the recent step-up in sightings of UFOs and our hearing more about contactee experiences.

Now, getting back to the Moon. Until I see some good solid scientific refutation of the case René has made that we've never been to the Moon, the idea of human space travel beyond a near orbit inside the protective shield of the Van Allen belt seems implausible. So the whole concept of installing and manning a radio telescope on the Moon's butt seems to me like just another scam to solicit funds from the uneducated credulous.

The Ham Impact

I keep rattling on, preaching to the choir about how much adventure amateur radio has brought me. So how about you? How has amateur radio changed your life? In business? In adventure? Friends? Get busy at your word processor and write about it. Give me some ammo to use in selling kids on our hobby. I'd love not just to print an article in *73* on the impact of hamming on your life, but maybe to gather a bunch of stories into a book so we can reach out and get the public aware of what a powerful hobby we have.

Even skiing down the slopes in Aspen this last January with some local hams was an adventure for me. English is an impoverished language when it comes to expressing feelings, so I can't adequately describe the thrill that I get when I'm zooming down a mountain with friends. Sure, bowling is fun when you're good at it, but skiing provides a rush that's beyond words. It's addictive.

So tell me about the adventures that amateur radio has provided you—how it's provided you with a career path. And get cracking, I don't want to have to keep reminding you, fighting your almost legendary ability to procrastinate.

Those ARRL Proposals (Rearranging the Deck Chairs)

You've probably read or heard about the rule changes the ARRL has suggested.

Look, there's one simple problem that has to be solved if amateur radio is going to be saved from extinction. We either get a whole lot more hams or we get blown away. Alas, to no one's surprise, the ARRL proposed rule changes are insignificant tinkering—designed more to create controversy among the hidebound than to solve our problem. It gives the facade that the League is doing something.

There are two major reasons why the public interest in amateur radio has gone from a bright fire to a small spark—from the time when there was prestige in being a ham to today's public yawn, they're not too sure what ham radio is. Reason number one is an almost total lack of promotion of the hobby. Number two is the continued maintenance of the code as what is all too often perceived as an insurmountable—a hazing—obstacle.

Sure, back in the 1930s, when I got interested in the hobby, and 90% of all ham contacts were via CW, there was some rationale for making sure that new hams knew the code. It didn't make a lot of sense to me then, since if I wanted to be active on CW I would have to learn the code, with or without a code test as part of the qualification.

Lowering the 13-per test to 10-per isn't going to do anything magic. Sure, the League will be able to continue to make money selling code courses, but it isn't likely to attract many more hams.

We need articles about hamming in the newspapers, in popular magazines, on TV, and so on. When I get on the Art Bell show and talk about amateur radio, I get thousands of letters from listeners wanting to know more. We have one of the best hobbies there is, and I've had a bunch of hobbies, so I know what I'm talking about. Amateur radio can help to provide a career path for youngsters that's right in tune with the times. It can provide adventure for hams of any age. As I keep explaining, amateur radio has provided me with a lifetime of adventure and friends.

What could be more fun for a ham than publishing a ham magazine? I've used that platform to visit hams in over a hundred countries and to operate from some really weird places. It was my contacts with Robbie 5Z4ERR in Nairobi that got me to organize a ham hunting safari. What a blast that was! Wow! I still remember the moment when Larry slipped on the wet moss and came tha-a-at close to falling into Murchison Falls in Uganda! And it got me to be a member of the US delegation at the International Telecommunications Commission in Geneva. It got me two weeks of operating from the king's palace in Amman, along with dinner with the king and queen of Jordan. It got me operating a ham station from the US Embassy in Iran, and from the DMZ between North and South Korea.

My success in helping ham repeaters with endless articles and books turn into a leading ham activity, which then spawned cellular telephones, got me to start *Byte* to help personal computers grow from a curiosity into a new industry.

And there isn't anything that I've done that anyone else couldn't have. I didn't start out with any money from my family. I always just barely squeaked by in school. Well, I did get involved with extracurricular activities a lot. Like the radio club, the Savoyards (singing Gilbert and Sullivan), the Choral Club, the Philharmonic Choir of Brooklyn, the camera club, stuff like that.

So, after all the adventure amateur radio has provided me, I really hate to see the hobby being destroyed by the League —through a religious obsession with the code and an almost complete neglect of promotion.

Books for Crooks

The Art Bell (W6OBB) show hits all 50 states, plus a good deal of Canada, via around 335 AM radio stations. The downside is that he's on for five hours starting at 11 p.m. Pacific time. That's from 2 a.m. in the east. Art's interviewed me three times so far and, judging from the response, his audience is biased towards older people, who tend to have trouble sleeping, truck drivers on long-haul trips, and prison inmates.

I encourage the people writing to tell me something about themselves. I've been surprised at the literacy and intelligence of many of the letters from prisoners. But they have a big problem: no money. Many really want to educate themselves, so they've been sending stamps to buy my guide to self-education, which is a review of around a hundred books about things they don't teach in school, but should.

These are not the kind of books they're going to find in their prison libraries, so how can they take the next step? I'd love to try and do something about this, but I can't handle everything I've already signed up to do. I envision a "Books for Crooks" program, run by some altruistic retired person who would like to score some points with St. Peter. The idea would be to buy some books and send them to inmates who will (a) promise to read them; (b) make notes on the contents; (c) return them within a week; (d) and pay $5 for each book they've read into a revolving fund after they've been released.

The program would need one person to handle the "rentals," and someone with the bucks to endow the startup of the operation. A hundred books might run $1,000 for the original inventory, though I'm sure that many publishers might cooperate with big discounts.

Of course our whole prison system needs an overhaul. It is *not* correcting behavior. And, as I'm sure you know by now, America has the largest percentage of its population in prison of any country in the world. Is that a hint that we have a problem? Please let me know if you're interested in helping to solve this problem. It needs to be done and I'm beginning to realize that I can't do everything.

Guts

After reading a bunch of letters from Art Bell show listeners, many from hams, I feel like preaching. The basics of my sermon today are simple. First, our educational system is not educating. Second, our health care system is not keeping us healthy. Third, our monetary system is a fraud. Fourth, our "correctional system" doesn't correct anything. Fifth, our Congress is mainly a bunch of ex-lawyers getting rich on bribes from lobbyists. Sixth, the administration isn't any better. And unless you have the guts to do something about it personally, amateur radio is going to go down the tubes with our frequencies sold to the highest bidders, which aren't going to be us. The ARRL is doing almost nothing to help save our bands, so who does that leave?

Oh, you whine, but what can just *one* person do? Step one is to do your homework so you know what you are talking about. Step two is to get yourself into gear and start making things change. One person can make a hell of a difference; it's just that so few people ever try. The movers and shakers do just that—they move and shake things up. But first you have to know what you are talking about and where best to put the pressure to get change.

It's a lot of work to become a world expert on some subject, but ridiculously easy to become an area expert.

Know what you're talking about and then start talking—and writing. Raise hell and put a brick under it. Our school system doesn't have to be one of the worst in the developed world. Our health care system doesn't have to be worse than many third-world countries' *and* be the most expensive in the world. Our prisons don't have to house the largest percentage of our population of any country in the world. You *let* all this happen. We don't have to have more government workers (and I use the term loosely) than we have in manufacturing.

Find out for yourself why any one of these disgraces has happened and start doing something about it.

Maybe you'd prefer to start with something less intimidating—so how about finding out for yourself what the situation is regarding the potential life of amateur radio? Don't believe me—do your homework—then start doing something about it.

All it takes is guts to change things. Got any?

Distant Learning

Technology is improving our ability to learn wherever we happen to be. We have books, audio tapes, video tapes, and TV. My favorite is books. You can't highlight audio or video tapes, or get to the part you want quickly via an index. And you can't throw nearly as much information into your suitcase when you're off on a trip. I always have a stack of books with me when I travel.

There are some things which really require video, like the learning of some skills. A few years ago I had the idea of putting the whole K-12 curriculum on video tapes, with each course being taught by a performer so it would be exciting. Even the otherwise most boring courses can be made exciting by a good performer. In this way the very best teachers in the world could be tapped. The unions would fight this to the death.

I had this crazy idea that this would be a great project for a university, providing K-12 courses for any parents really interested in seeing their children actually learn and have fun doing it. Kids could leave their classmates behind in the dust. As John Taylor Gatto, the prize-winning teacher, points out: It only takes about a hundred hours for a child to learn to read and write.

John quit teaching, saying that he couldn't keep doing that to the kids. I've reprints of two of his talks, which go into what's wrong with our school system and why it is doing so much damage to our kids. $3 from Radio Bookshop.

Another War Lost

Hmm, let's see now. Which president declared a war on drugs? Well, we lost it. Johnson declared war on poverty. Another lost war. Nixon declared war on cancer. So here we are 26 years later, with $32 billion supposedly spent on cancer research, and more people are dying from cancer today than in 1971. Those vaunted cancer drugs? All they do is give the patient a few more months of painful life. One in three Americans will get cancer and a half million will die this year.

Cancer, as I've mentioned before, is not caused by God. We do it to ourselves through poisoning our bodies and malnutrition.

Poisoning ourselves? Like smoking, for instance. Malnutrition? Just look at the junk people are taking through the checkout counters at the market for their families and you'll see why heart disease is the number one killer, with cancer closing in fast. You wouldn't mistreat your car the way you do your body. 73

Number 87 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 E Chateau
Payson AZ 85541

As I write these words in mid-April (and you read them in June), July propagation is particularly difficult to predict. Last week, Old Sol suddenly awakened from his long sleep and produced major solar flare activity—the greatest in years—accompanied by groups of sunspots breaking out on the solar disc. While this is encouraging news, the old saying "one swallow doesn't make a summer" still applies, because there is no assurance that the renewed activity will continue or increase over the next three months.

However, my best guess is that the ho-hum conditions of the past two years have changed and we can expect to see greatly increased DX opportunities beginning this fall.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						20	20					
ARGENTINA	20	20	20	40			20	20	15	15	15	15
AUSTRALIA		20	20	20	40	40	20					
CANAL ZONE	15	40	40	40	40	40		15	15	15	10	10
ENGLAND			40	40			20	20	20	20	20	20
HAWAII			20		40		20	20				
INDIA												
JAPAN							20	20				
MEXICO	15	40	40	40	40	40		15	15	15	10	10
PHILIPPINES							20					
PUERTO RICO	15	40	40	40	40	40		15	15	15	10	10
RUSSIA (C.I.S.)							20	20		20		
SOUTH AFRICA			40	40		20	20				20	
WEST COAST	20	40	40	40	40	40	40					20

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA		20	20					20	20			
ARGENTINA	15	20	20	40			20	20		15	15	15
AUSTRALIA	15	20	20	20	40	40		20			20	
CANAL ZONE	15	20	20	20	40	40	20	20	15	15	15	10
ENGLAND	20	40					20	20		20	20	20
HAWAII	15	15	20	20	20	40	20	20				
INDIA												
JAPAN		20	20					20	20			
MEXICO	15	20	20	20	40	40	20	20	15	15	15	10
PHILIPPINES		20	20				20	20				
PUERTO RICO	15	20	20	20	40	40	20	20	15	15	15	10
RUSSIA (C.I.S.)								20			20	
SOUTH AFRICA							20				20	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA		20	20						20			
ARGENTINA	15	20	20	40	40			20	20		15	15
AUSTRALIA		20	20	20	20	40	40		20		15	15
CANAL ZONE	15	15	20	20	40	40		20	20	15	15	15
ENGLAND	20							20	20			20
HAWAII	20	15	15	20	20	20	40	40	20		20	20
INDIA				20					20			
JAPAN		20	20						20			
MEXICO	15	15	20	20	40	40		20	20	15	15	15
PHILIPPINES				20					20			
PUERTO RICO	15	15	20	20	40	40		20	20	15	15	15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA			40						20			
EAST COAST	20	40	40	40	40	40						20

JULY 1997

SUN	MON	TUE	WED	THU	FRI	SAT
		1 G-F	2 F	3 F-P	4 P	5 P-F
6 P-F	7 F	8 F	9 F-P	10 P	11 P-F	12 F
13 F-G	14 G	15 G	16 G	17 G	18 G	19 G
20 G	21 G-F	22 F-P	23 P	24 P	25 P	26 P
27 P	28 P-F	29 F	30 F	31 F		

This month's calendar shows seven days when propagation is likely to be Fair, six Poor days, seven Good days, and eleven trending days: four trending toward downward and seven trending upward.

The 4th, 10th, and 23rd through 27th are likely to exhibit a very uncooperative and disturbed ionosphere because of other geophysical upsets occurring on earth, such as unusual weather and the onset of a violent hurricane season, for example.

Your best DX opportunities are likely to occur between the 14th and 20th, so stay alert and make the best of your chances during this period. Since July is the beginning of the vacation season, and mobile-portable hamming is at its peak, plan on having lots of fun with both DX and short skip wherever you may be! W1XU.

Band-by-band propagation this month

10–12 meters

Occasional intense sporadic-E propagation may provide openings to 2,000 miles or more, while frequent short-skip openings out to 1,000 miles or so can occur on Good (G) days.

15–17 meters

Frequent short-skip openings to 1,500 miles and occasional long-skip openings on north-south paths across the equator are expected on Good (G) days.

20 meters

DX to all parts of the world can be expected on this band from sunrise to sunset on Good (G) days, with peak conditions usually occurring a few hours after sunrise, and again in the late afternoon. Short skip to 2,000 miles or so may be expected as well.

30–40 meters

Consistent nighttime DX to all parts of the world is expected from sunset to sunrise, with possible exception of poor reception due to high static levels during thunderstorm activity. Short-skip openings averaging 500 miles during the daytime and 1,500 miles at night are anticipated.

80–160 meters

Nighttime DX on 80 and 160 can be fair this month, with the exception of high noise levels on both bands from thunderstorms. Daytime short skip of a few hundred miles is possible on 80 but not on 160. Short-skip propagation is expected at night on each band, and ought to be fair out to perhaps 1,400 miles or so, but limited by QRN. 73

WANTED

Fun, easy to build projects for publication in *73*. For more info, write to:

Joyce Sawtelle,
***73 Amateur Radio Today*,**
70 Route 202 North,
Peterborough NH 03458.

Including Ham Radio Fun!

73® Amateur Radio Today

AUGUST 1997
ISSUE #443
USA $3.95
CANADA $4.95

International Edition

Marine Mobile Info

The Killer Beam

Reviews:

Agrelo DFjr

Sony New SW Rx

Business Office
Editorial - Advertising - Circulation
Feedback - Product Reviews
73 Amateur Radio Today Magazine
70 Route 202N
Peterborough NH 03458-1107
603-924-0058
Fax: 603-924-8613

Reprints: $3 per article
Back issues: $5 each

Printed in the USA by
Quad Graphics

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article [IBM (ok) or Mac (preferred) formats], carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

Including Ham Radio Fun!

AUGUST 1997
ISSUE #443

73® Amateur Radio Today

TABLE OF CONTENTS

FEATURES

REVIEWS

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: Thanks to Ray Blowers N2ODA of Penn Yan NY for this shot of his repeater site at Biuff Point, in the heart of the Finger Lakes. The ten-foot dish is for NASA rebroadcast; Ray carries the missions from 6:00 a.m. to 11:00 p.m. for as long as they're up. The eight-foot solid dish (Ku) is for Saturday night's "This Week in Amateur Radio." Next month: your cover photo — if you remember to send it.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The entire contents ©1997 by 73 Magazine. No part of this publication may be reproduced without written permission of the publisher, which is not all that difficult to get. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Milestone

Or millstone, depending on how one looks at it. In a few weeks (September 3rd) I'll be 75. I've achieved this miracle by not falling off high buildings or towers when installing ham antennas, by my boat not getting sunk by the Japanese in World War II (not for any lack of diligence on their part), and by not getting caught by potentially irate husbands.

Then there were the two times on my first DXpedition to Navassa (KC4AF) back in 1958 when we darned near got killed. Come to think of it, all of the close calls I've had in life involved amateur radio. And that doesn't count getting a 2,000V jolt one night. Boy, did that knock me across the room! That was back in 1938, when I carelessly got across my 40m rig power supply.

One of the reasons I am such a persistent itch about your getting more involved with different aspects of the hobby instead of mindlessly rag-chewing what's left of your life away is the adventure that the hobby has provided me. I won't trot out my been-there-done-that list. Well, you'd just grumble that I was bragging. I've had a very adventurous life by most people's standards, thanks to ham radio. And imagine "working" at your major hobby for most of your life!

As Robert Frost said in "Two Tramps in Mud Time."

My object in living is to unite
My avocation and my vocation
As my two eyes make one in sight.

Which explains two things—my own decision in 1955 to go into ham radio publishing, leaving an enormously successful career in manufacturing a high tech product—and my constant preaching that the shortest route to success in life is in marrying your personal interests with your career.

It also helps explain the extraordinary success of the Sudbury Valley-type schools, where the kids learn what they want when they want instead of being regimented, cookie-cutter style, into memorizing and then forgetting irrelevant baloney for 12 years. Or 16, if they've really been suckered by the system (like I was).

To Recap

Back in 1951, after having worked as a radio announcer and engineer, and then a television engineer as chief cameraman for WPIX (Channel 11) in New York and then as a producer-director at KBTV in Dallas, I tried working as a project managing engineer for Airborne Instrument Laboratories in Mineola, NY. This job confirmed for me that I really didn't want to be an engineer, so I spent much of my time sending out résumés to TV stations. It also taught me that the military is a grade-A sucker when it comes to R&D projects. Oh, the incredible wastes of money I saw there! Hundreds of millions of dollars.

John Karlson, an engineer on one of the projects I was managing, had invented a new kind of wideband omnidirectional microwave antenna. Hmm. I said, since microwaves and audio have the same wavelengths, this should work as a loudspeaker enclosure too. So, when a TV job clicked for me at WXEL in Cleveland as a producer-director, I loaded Karlson down with lab equipment from my ham shack so he could develop a prototype speaker system. I had a General Radio audio generator, a Dumont oscilloscope, an RCA-88 broadcast quality microphone, and so on.

A year later I was really fed up with my TV job. It combined low pay, high responsibility, and enormous stress. The station was mostly network, but I was producing and directing the local shows, with one, the Sohio News, being fed to TV stations all around Ohio. But producing news, news commentary, and sports roundups wasn't what they'd promised me. It was a real grind and not much fun, so I quit and went back to New York to see how Karlson was doing. He'd made almost no progress, so I spent a couple months with him in our anechoic chamber (an open field on Long Island) getting the speaker system into shape. It produced incredible sound! Nothing else on the market could even come close.

Neither of us had any money, so now what? We demonstrated it to Avery Fisher of Fisher Electronics, one of the big audio firms. Maybe you've heard of Avery Fisher Hall in New York? Avery listened and offered us a 4% royalty for him to market it.

I thought we ought to be able to do better than that, and besides, I liked the idea of building our own company instead of just doing R&D for someone else. So I went to the bank and borrowed $1,000 on my car, got a few enclosures made at a local wood shop, and took them to a few hi-fi stores to demonstrate. Oh yes, the size of the box was determined by the door of my car. I had to be able to get the box into the back seat to take it around.

The stores heard and ordered. But this was a slow growth system, so I next got an article on the enclosure published in *Radio News*. This brought in a big bunch of mail orders—money up front, which you don't get from stores. Working capital.

We demonstrated the system at hi-fi shows all around the country, wowing audio enthusiasts with the incredible sound we could produce from such a small box. Within two and a half years it was the largest-selling enclosure in the country, with four factories in the east and three in California busy turning them out for us. We went from a small bank loan to selling over $2 million a year, and that was in 1950 dollars. That would be about $20 million in today's dollarettes.

So why did I walk away from this in 1955 to become the editor of *CQ*? Because it was a grind. Factories to run, manufacturers' reps to manage, audio shows every few weeks somewhere, advertising deadlines, inventories, and so on. Building the company was fun and exciting, but just running it wasn't. I was having more fun with my ham teletype experimenting and with my little spare time *Amateur Radio Frontiers* magazine, which was about ham digital communications.

Karlson was anxious to quit his job with Airborne and come out of his R&D lab to run the company, so I changed careers to publishing. The company was out of business a few months later. It's a pity because I've listened to every speaker system on the market today and none comes close to the sound our old systems produced.

An article on Richard Wurman in *Fortune* (6/23/97 pp.106-116), who runs technology

seminars for the country's top business brains, says he advises in his 1989 book, *Information Anxiety*, "Your work should be an extended hobby." If the Sudbury School hadn't been invented I think Wurman would have invented it as the answer to "our rotten schools." His philosophy is to "indulge ideas."

I'm doing my best to take care of my body so I'll be around for another 25 years or so, so I can continue urging you to get out of the rat race, to stop sucking into commuting to work, build your own company, and to get your kids into a Sudbury-like school and forget college unless we can get the damned things reinvented to do the job that needs to be done and out of their 19th-Century mindset.

I've got a life and, I hope, a few years left to get you to have one too. There's tons of land open up here in New Hampshire for antenna farms, so why are you living in an apartment or a community that doesn't allow antennas? Wise up!

Sucker!

First, I doubt that you are going to believe me. Second, you're probably going to get angry—most likely with me. My message is simple: Sucker, you've been hoodwinked (a.k.a. brainwashed) into believing a bunch of baloney. Hey, I was a sucker too, so I know how it feels. As they say, "Ve get too soon old and too late schmart."

What's Wayne going to blast this time? The ARRL? The FCC? Congress? If you truly believe in any of those, yes. But basically, no—I'm going much deeper, into the very heart of your beliefs. Deep into your religiously held beliefs. Like your belief in the value of college, the work you do, your doctor, our political system, the food you've been eating, the water you drink, our school system, our currency, immunization, and so on.

College is for suckers. Going to the doctor is for suckers. Your job is probably a sucker's job. The food you've been buying is sucker's food. The so-called war on cancer? Smoke and mirrors. The war on drugs? More smoke. The Constitution? Not in *our* courts! Our legal system? Har-de-har! It's been so prostituted by lawyers that it's a beyond being a joke. Lawyers become our judges and legislators, compounding the mischief, and mainly for the benefit of lawyers. And we're paying the bills—we suckers. You and I.

We all believe in the value of a college education, so how can I trash that? Because we've all been sold a bill of goods. Flimflammed. I wasted four perfectly good years of my life because I didn't know any better. Years when I could have been laying the groundwork for a real life instead of being another drone in a corporate or bureaucratic hive. I love the way our beloved government takes our tax dollars to provide a free college education for criminals, and how we encourage kids to go into hock, "investing" in years of useless memorizing and tests, which is grinding, fruitless work, little of which is ever going to be of the slightest use in their lives.

If you work for a large company, the government, or in education, you've been conned. If you are commuting more than 10 minutes a day each way to work, you've been suckered. If you don't own your own company by the time you're 25 you've been had by the system.

In a large company, working for the government, or in education, you'll never know freedom, no matter how high you climb the ladder. Practically speaking, the only way you'll ever make enough money to earn freedom is to be an entrepreneur and own your own business.

Yes, I know about the multimillion dollar salaries and benefits of some sports stars and megacorporation honchos. How much freedom do you think these people have, even with all their money? But I'm not interested in the success of a few exceptions; the nitty-gritty is in how any kid, family problems or background notwithstanding, can beat the system and be a winner.

Our public school system (and most private schools) is geared toward making sure you emerge as one of the hive, unable to question or think—barely able to read, unable to do even simple math or read a map—with almost zero motivation to change, and little perseverance when some sparks of motivation are struck. Aided by the media (newspapers, magazines, TV, radio), it hangs you up on total inconsequential amusements like watching sports, sitcoms, Oprah, and 98% of the other TV goulash aimed at the lowest common denominator (does that describe you?).

Yes, there are a few schools which have broken the mold (like the Sudbury Valley School), and yes, colleges could be re-engineered to provide a practical education which would help gear the graduates toward success as entrepreneurs. I tried my hand at edging Rensselaer Polytechnic Institute in that direction, but I didn't have a big enough lever to change tradition, even though I was on the Steering Committee, the RPI Council, a Rensselaer Patroon, and First Executive in Residence. Reason, I found, couldn't compete with tradition.

Well, it's probably too late to wean you from watching baseball and football, or from commuting to and from a job with little future, but perhaps I can get you to at least give your kids a break. Or grandkids.

Heck, you can turn over a new leaf at 70 and within five years be free. Of course, that's if you haven't ruined your body beyond repair with too little water, lousy food, and endless poisons.

So what's the alternative to having a job? To being a wage slave? How do you get from working at a job to owning a business? My booklet, *Making Money, A Beginner's Guide*, gives the details, but basically I recommend that youngsters decide what field will be the most fun for them, find an entrepreneur in that field with a small company and go to work as an apprentice. This approach actually will work for anyone from 17 to 70. Every small company has work that needs to be done and no one to do it. I'm not going to expand this into another booklet covering the same stuff, so get the book and then argue with me.

Entrepreneurs have to know a bunch of things, so get busy and educate yourself—with someone else paying for your education. Learn about sales, marketing, promotion, advertising, contracts, business law, purchasing, accounting, computers, communications systems, and so on.

For instance, if publishing looks like fun to you, you'll want to learn about advertising sales, circulation management, newsstand sales, list management, fulfillment services, desktop computer systems and printers, type readability, and so on. Learning spelling and grammar won't hurt either. That means reading every book you can find, subscribing to the key magazines, attending conferences and lectures, getting together with people in other publishing firms, and so on. Apply that same routine to any field that looks like fun. After all, why work when you can have fun and make money at the same time? Then it doesn't seem like work. Why do you think I started a ham magazine 37 years ago? And oh, the adventures and fun I've had as a result!

Once you're making plenty of money and have freedom, then you can get busy helping me solve our country's more serious problems. We don't have to have much crime. We don't have to have the country run by lawyers for their own benefit. Or controlled by the international megacorporations. We don't have to put up with a crooked Congress.

I know you haven't a clue about where our money supply comes from, else you'd have been writing to me, bitching about the incredible scam. Wow, have we all been suckered on that one!

So, are you going to continue on, fat, dumb and unhappy, or are you going to start wising up

Continued on page 40

LETTERS

From the Ham Shack

Charlie Smith KE4OZN. Ask yourself a question. Why is the ARRL leadership so determined to destroy amateur radio? The League reports that in 1996, the organization lost about $700,000 in operations. The board gave two primary reasons. First, sluggish sales of amateur equipment, which translated into fewer advertising dollars being spent by manufacturers, retailers and distributors. Also, fewer orders of ARRL materials. Second, a decrease in new amateur licenses and upgrades. The ARRL board has responded in several ways. First, the administration and finance committee established a fund for the defense of amateur radio frequencies. The League reports in the March issue of *QST* that to date, more than 11,000 members have contributed more than $405,000 to the fund. Second, the board has chosen to increase League dues to $34 annually—an increase of roughly 10%. The problems with these decisions are, or should be, evident to everyone (except ARRL directors and at least 11,000 League members?). The ARRL doesn't seem to understand that these "problems" are easily solved. And nothing the League is doing is the answer. Instead of recommending an increase in dues, developing a defense fund and supporting a complete overhaul of amateur licensing requirements, including retaining the Morse code requirement, even if international code requirements are dropped, how about coming up with *real* solutions? How about making an effort to recruit new blood? New amateurs need equipment. Increased sales means greater advertising dollars being spent, increased ARRL publication sales, and possibly an increase of League membership. And how about lowering membership dues, at least for first time members? It makes more sense to make a little less per sale, but increase overall income by having more members if you can't sell 'em at $10 each. You probably won't (read: never in a million years) sell more by raising the price to $12. Try it sometime. More amateurs mean more usage of amateur frequencies. With a lot of people using the bands there is no need for a fund to defend our access to spectrum allotted to us. There is strength in numbers. Doesn't it make more sense to spend $405,000 to recruit than to defend? Not to ARRL directors and 11,000+ members. Why put so much energy into defending our hobby when all of our so-called problems will take care of themselves if we grow? How about stopping this nonsense about restructuring and renaming the different "classes" and simply scrap it all in favor of a one class system where those who pass a simple (roughly Technician class) test are welcomed into our ranks and simply known as "hams" or "amateur radio operators." Why continue a caste system? People will increase their knowledge and skill, or, if you feel this would be lowering "the standards," how about making everyone pass all requirements currently held by Extra class amateurs? That would improve the "purity" of our hobby greatly. Better yet, increase code requirements to 40 words per minute and eliminate all other modes of operation. It'd free up more spectrum for "real radio" (CW). And only allow homebrewed gear. I mean, don't "real" amateurs build their own stuff? Oh, how about an age requirement? How old is old enough? 40, 50, 70? And while you're at it, eliminate women from the ranks. And finally, limit the hobby to HF frequencies. Where will amateur radio be in 10 years? 20 years? If the ARRL continues down Stupid Ave., it'll all just be a memory. If it does survive another 20 years, radio stands a chance—as the bulk of ARRL's membership will be dead. Then, maybe those who remain will finally get a clue. Think about it.

Another troublemaker! The League has set aside funds for defending our frequencies for years. I remember when these funds were used for vacation visits to the Caribbean by a League president. And wow, did I see the membership money being thrown around recklessly at Geneva! But Charlie's right, we need new hams. Young new hams. Millions of young new hams. It would be good for amateur radio, good for the kids, and particularly good for our country. But since experience has shown that youngsters are interested in using computers instead of keys, they may not be welcomed by the League directors ... Wayne.

Mark McClure, Coral Gables FL. I just finished another Wayne Green editorial and I'd like to take a moment to say thanks for your booklet, "Making Money." I've taken your advice and become an expert in a field—courtroom technology—and I'm starting to reap the benefits. My wife and I just returned from a trip to India, Singapore and Malaysia. The company I contracted with paid all of my expenses and my wife flew on a frequent-flyer ticket, obtained primarily by running as much through our frequent-flyer Visa card as possible, as you have suggested. I'm not rich yet, but last year was my best year ever, and I owe a large part of it to your editorials, which exhort and cajole us to push ourselves. I really look forward to the late part of the month when your magazine arrives. I especially enjoy your non-radio topics. For me DXing and rag-chewing can't compete with the Internet, though I get on two meters from time to time and I'm on the board of directors of the local RACES team. In your editorials you often state that most of us don't take your advice and are too busy with ball games. Well, not all of us. I really appreciate being able to benefit from your knowledge and experience and I hope to continue to read your editorials for many years to come.

Thanks, Mark, that's really encouraging; now will someone please explain how I can get the rest of the readers to shape up? Anyone can add years of healthy living to their lives and make all the money they want, if I can just get them to start breaking their unhealthy loser habits. Sigh ... Wayne.

Harold Oroppe, Jr. K6QVD. I read with interest William Tilburg KG8AN's article on page 48 of the May issue #440 describing the half square DX antenna. However, I feel that credit should be given to Antennas West, Provo, Utah, and Jim Stevens KK7C, who has been advertising this antenna for many years, assembled or in kit form, in *73 Magazine*. Refer to page 31 of the May issue for his ad. I have personally used this antenna with phenomenal success for many years, even before our home was destroyed in the October, 1993, (Laguna Beach CA) firestorm along with almost 400 others. Antennas West is unique in that it offers many innovative antenna designs plus a ream of technical data that is straightforward and honest in an industry plagued with snake oil and exaggeration. For example, all of their antennas use custom-made Quiet Flex™ wire. This wire has more than 40 strands lightly twisted together under flexible insulation. It will not kink; snow and ice slip off before they can load it down; and acid rain and invisible pollution that corrodes the surface of ordinary antenna wire cannot penetrate the tough cover. This insulation withstands high heat and remains flexible at below-zero temperatures. Year after year it refuses to crack or harden under the bombardment of untraviolet rays. Quiet Flex is rated at 3,500 volts, which offers protection in unfamiliar locations. Most hams don't realize the corrosion that builds up on ordinary cheap bare stranded antenna wire acts like several hundred feet of tiny semiconductors. When wind sways the antenna, the strands rub together, and this generates noise. Noise generation starts within only a few weeks of the initial installation, before you can see the buildup of corrosion, and the noise increases relentlessly over months. Quiet Flex wire starts out quiet and stays quiet over the years ... and the price is right! I speak from experience, as I've lived a mile from the ocean for the past 31 years and have been a ham for 61 years. My original call was W6NHS in January 1936 in Hollywood, and ex-W2, W3, and W6/K6 after WWII.

Alan Plotnick NN1X. Can you tell me who makes an attaché case HF transceiver today? I know that suitcase transceivers were made during World War II, but it seems very strange that no radio company ever picked up on the idea and modernized it. With miniaturization, advanced rechargeable batteries and the need to compete with UHF HTs, this product seems to be just

begging to be introduced again. It would be great for Field Day as well as the home shack. And it wouldn't need to be another feeble 5 watt QRP rig. What about it?

Bummer, seems to me. Many rigs are small enough to throw into an attaché case, but since most of us just set a rig up on a desk and use it, the attaché case would be in the way. I don't remember any attaché case rigs in WWII, and I was there. I don't think attaché cases were even invented until the 1950s. We had book bags and briefcases before that. Certainly, nothing like that ever showed up on the surplus market after the war. And those were tube days, so rigs weren't all that small. Sure, you could have squeezed a BC-456-sized rig into a briefcase, but the power supply would have made it a real bear to carry ... Wayne.

Dorothy AA2VL. I would like to nominate Frank WB2IJZ (Wet Bottom) for a "Good Apple" certificate.

Frank has had a license since 1963. He keeps saying he knows he could pass to upgrade. I believe he could, but he doesn't do it.

Frank has been Net Manager of the Early Birds, Western New York area, for about 15 years. He is right on the job 5:25 a.m. Monday through Friday. He doesn't have to worry about losing his manager job; no one is waiting in line to assume the responsibility. He does a very good job and deserves a Good Apple Certificate for being a dedicated ham.

Richard Harrison KB5WZI. Our ARRL Section Manager addressed our club recently. He strongly promoted the League's ability to protect and preserve ham frequency bands. As cost-cutting and deregulation eliminate spectrum policing, technology, commerce and influence take away ham frequencies. The ARRL would like us to believe that it mitigates this erosion. Other than electing hams to Congress, only a sizable pro-ham population or a sizable influence purchase can improve our status. Some hams deny a problem exists. Others believe the ARRL will cope, and still others hope the problems will go away. Influence comes from people and money. Yet, many hams say more is not better. As Vince Lombardi would say, "It's not the best thing, it's the only thing." It takes numbers. Influence will result from a sizable segment of society perceiving significant self-interest in ham radio. We need more hams, and we need to convince the public that ham radio is a good source of able technicians for the information revolution. The occasional cell phone logjam can produce pro-ham publicity for a while, but non-ham wireless growth will shrink these stories. The ambassadorial role of ham radio is not too persuasive. The worst conflicts seem to occur between those who know each other best.

Ham radio stimulates interest and progress in electronics. Hams are self-motivated to investigate and experiment. This education is the real value of ham radio. Young people are likely to benefit most from this experience and benefit their communities in turn. The success of small activist groups comes from persuasion of outsiders to share their causes. Hams also need others to back ham causes. It is unlikely that any ham lobby could successfully compete with commercial interests now. Interested hams are a tiny fraction of the population. The public doesn't show much support for hams. Hams mess up telephones, radios, televisions, stereos, and other stuff too, don't they? How about money? How many millions were given in the name of ham radio to various election campaigns? How about access to the regulators? Do you think ARRL buys better lunches than AT&T? Commissioners are political appointees. In turn, bureau chiefs get the nod from commissioners. These guys usually are seeking a steppingstone to better places. They find them, too, through the commercial interests they regulate. In their new positions, they can return to influence their former colleagues. In opposing this entrenched system, ARRL can only skirmish. Any pretension otherwise is less than candid. To save ham radio, you have to grow it, and make allies.

Another troublemaker trying to use reason to penetrate closed minds. It won't work ... Wayne. 73

QRX . . .

Remember the Glory Days—and the Good Manners—of Ham Radio?

In talking with another old-timer. I was reminded that in the old days we were all scared of the FCC. His logbook, like mine, was filled with line after line of unanswered CQ calls. The rules said to record all transmissions, so that's what we did. Contacts that we made or unanswered CQs all were dutifully recorded. We were convinced that if we accidentally violated the edge of a band or let a profanity slip out, that there would soon be a knock at the door or a "pink slip" in the mail. To this day I still go no closer than 5 kHz to the end of a band.

Courtesy and proper radio etiquette were commonplace. Phone transmissions were always preceded by, "Is this frequency in use?" We all felt that we were privileged to be on the cutting edge of an exciting new field. We had worked hard for our licenses and were proud of our role. We relayed messages from servicemen overseas to their loved ones at home. Sometimes we were even privileged to be able to set up a phone patch and share in the joy of a reunion. In times of disasters and national emergencies we were a vital link that often helped save lives or bring comfort to worried family and friends.

There were glorious adventures to share. I remember how thrilling it was to talk to the crew of "Kon-Tiki" as they sailed their raft across the Pacific. I remember listening to hams aboard our spacecrafts as they circled the globe. I remember talking to my daughter aboard a research vessel exploring the mid-Atlantic rift. All this, and much more, with equipment that we had put together with our own hands.

Today it's FAX-modem this, Internet that. I've got more money, so I bought a fancier station with more power and a bigger antenna. And, what's worse, it's no longer a group of proud people sharing the fraternity of radio communications. When I tune across the bands today, I hear people giving religious sermons, people spreading messages of hate, and people cursing each other in the most vile and obscene language. Then there are those who seem to take delight in jamming contacts and those who deliberately interfere with various nets. They have the lamebrained idea that they are defending liberty and that no group of people has the right to use any particular frequency for longer than they feel is appropriate.

As a retired psychologist, I can describe the jammers and the interferers as remarkably similar groups of people. For the most part, they all suffer from poor self-image and weak egos. They are busy overcompensating for inferiority complexes.

The question is, what do we do about these immature individuals who are ruining amateur radio for the rest of us? Unfortunately, there is little likelihood of any of them growing up without seeking professional help. Yelling at them only feeds their egos, making them feel important. It's best to treat them the way you would any group of little kids calling names. Ignore them and most of them will get bored and go away. These misfits typically have little ability to delay gratification. If they find they can't bother you they'll get frustrated and find someone else to annoy.

The other solution is to have the FCC act as "Big Brother." When emotional development is arrested or regresses to such an infantile level they either do not have any self-discipline or have lost whatever self-discipline they may once have had. They only function, and even then poorly, *when they are subject to* constant external discipline that reacts strictly and rapidly. The FCC would have to constantly monitor the bands and confiscate equipment, fine, and even imprison these individuals. I am not sure that any ham in the land of the free wants to be subjected to that kind of scrutiny. So let's not get angry and fight with these immature, mentally disturbed people. They deserve our sympathy, not our scorn. Try to not let them bother you.

However, there is one area where we should take an active interest. Stop and think for a moment. What person, in his right minds, would spend so much time and effort on destructive behavior, devoted to destroying other people's enjoyment? If you know one of these people, you owe it to him to get him some help. This destructive behavior can only get worse and eventually end up in self-destructive actions. You are your brother's keeper. Get him into therapy before it's too late.

In the meantime, we old-timers can remember back to the glory days of ham radio and all the joy and excitement it gave us. We can shed a tear for the youngsters who were born too late to share it with us. But, maybe there is still hope for them in areas of amateur communication that are still evolving.

By Hal "Doc" Goodman W3UWH, 7 Perkins Road, Eastport ME 04631.

Ode to Volunteers

Many will be shocked to find
When the day of judgment nears,
That there's a special place in Heaven
Set aside for volunteers,
Furnished with big recliners,
Satin couches and footstools.
Where there's no committee chairman,
No group leader or car pools;
No eager team that needs a coach,
No bazaar and no bake sale.
There will be nothing to staple,
Not one thing to fold or mail.
Telephone lists will be outlawed,
But one finger snap will bring
Cool drinks and gourmet dinners,
Rare treats, fit for a king!

You ask, who'll serve
The privileged few, and work
For all they're worth?
Why, all those who reaped
The benefits, and not once
Volunteered on Earth!

Author unknown, submitted by Jack Kirkpatrick K8BWX to the *SMARS Feedback* newsletter, August 1996, and reprinted in *RF-Carrier*, Dayton (OH) ARA, March 1997.

Ham Radio Volunteer Services Bill Introduced

Good news for ham radio volunteers: the Amateur Radio Volunteer Services Act of 1997 (HR 1013) has been introduced by US Rep. Anna Eshoo of California. If enacted, the bill would place volunteers in the Volunteer Examination Program and the Amateur Auxiliary under the protections of the Federal Tort Claims Act by affording them the same legal protections as employees of the federal government while they're carrying out such volunteer duties. "This bill would help protect the personal liability of volunteer Amateur Radio operators while performing duties on behalf of the federal government," Eshoo said in introducing the measure. As she explained it on the House floor, it's simply a question of fairness for volunteers, who risk damaging lawsuits while saving the government time and money. The bill was introduced with 21 co-sponsors hailing from both parties.

HR 1013 is nearly identical to a bill introduced last year but not enacted and similar to a unanimously accepted *amendment* to the FCC reauthorization bill that Eshoo herself offered last year in the Commerce Committee.

On the House floor, Eshoo outlined the rationale behind the Amateur Radio Volunteer Services Act of 1997 in these words, and urged her colleagues to support the bill:

"Amateur Radio operators are self-regulated, with volunteer operators monitoring the airwaves for violations and administering licensing exams. This volunteer corps saves countless hours of staff time and resources for the Federal Communications Commission; however, because they are not federal employees, they put their personal assets at risk in the event of actions taken against them as a result of their volunteer service to the government. It is simply unfair that these volunteers who are saving the government time and resources should have to risk their personal assets in carrying out their service. The Amateur Radio Volunteer Services Act would classify those individuals donating their time and expertise to maintaining the quality of the Amateur Radio airwaves as federal employees only for the purpose of actions taken against them in the performance of their duties as self-regulators. This action will ensure the continued viability of the Amateur Radio community and continue to save the FCC and the federal government time and money that would otherwise need to be expended."—ARRL.

From the *Tuned Circuit*, monthly bulletin of the L'Anse Creuse ARC (MI), April 1997.

More Vanity Callsign Follies

The FCC has granted another 420 or so vanity callsigns, representing vanity applications received between February 6 and March 4. Some 330 of the applications ended up in the work in process or WIPS stack, many because the FCC was unable to issue any of the applicants' callsign choices. The vanity callsign program remains popular: During February and March, the FCC received 1768 vanity callsign applications, the majority of them filed electronically.

A reminder: Vanity applicants who did not get one of their callsign choices will have to apply in writing for a refund of the $30 filing fee. The FCC will mail to all unsuccessful applicants a copy of the application (including FCC processing numbers) and a copy of their check. To request a refund, applicants then must send a letter to the FCC, 1270 Fairfield Rd., Gettysburg PA 17325-7245, along with their taxpayer ID number (Social Security number). The FCC still has not said when it plans to open Gate 3 for Advanced class vanity applicants.

From *Harmonics*, official publication of the South Jersey Radio Association, April 1997.

CQC Top Ten Uses for a Computer in the Ham Shack

10. You can use it as a really big paperweight.
9. It keeps your coffee warm.
8. It makes a great door stop.
7. You can check your E-mail while your keyer sends CQ.
6. You get to say "Sorry, Old Man, you're not in the computer."
5. It keeps dust from settling on the surface it covers.
4. If lightning strikes, the computer might absorb it and thereby protect your radio equipment.
3. You can check the packet net to see who's on air—much easier than actually turning on your receiver.
2. You can justify your new rig as a "computer upgrade."

And the Number One Use for a computer in the ham shack:

1. Three words: Random signal generator.

From Low *Down*, official journal of the Colorado QRP Club (cqc@aol.com).

Ham Radio Excluded from CB Enforcement Bill

At the request of the ARRL, Amateur Radio has been specifically exempted from a bill submitted April 17 by US Senator Russell Feingold (D-Wisconsin) that would give states and municipalities authority to enforce the FCC's CB regulations. Feingold's bill, designated Senate Bill 608, originated with efforts by the Beloit WI City Council—responding to long-standing CB interference complaints—to pass an ordinance allowing local authorities to enforce FCC regulations. The bill is aimed at reducing radio frequency interference stemming from the use of unauthorized equipment or frequencies by CBers.

In presenting his bill, Feingold told his Senate colleagues that he has received RFI complaints over the past several years from numerous Wisconsin communities "in which whole neighborhoods are experiencing persistent radio frequency interference."

If approved by Congress, Feingold's bill would amend the Communications Act to allow state or local governments to enforce regulations that prohibit the use of CB equipment not authorized by the FCC (such as high-power linear amplifiers). As it now stands, no license is required to operate on the 11-meter Citizens Band, but the FCC does have strict requirements on the type of equipment that CBers can legally use. Feingold called his bill "a common-sense solution to a very frustrating and real problem which cannot be addressed under existing law."

TNX *Tuned Circuit*, monthly bulletin of the L'Anse Creuse (MI) ARC, May 1997.

Free Repeater, Free HTs and Some Good Ol' PR

Would your *employer pitch in?*

Jim Kocsis WA9PYH
2217 Hidden Oaks Court
South Bend IN 46628

I had received an E-mail message at work from our Emergency Preparedness Coordinator (EPC). He had broadcast an E-mail message to all the people at our facility asking for all ham radio operators to attend a meeting to discuss hams' providing emergency communications. I replied with the names and business phone numbers of the hams I knew at work.

First contact

At our first meeting we talked about communications over and above what is provided by our five security guards. (Like most other companies, we've downsized and as a result have a much smaller security force than we used to have.) The idea of hams helping in an emergency came from the company where our EPC used to work, Rockwell International in southern California. Rockwell had around 8,000 employees in a 208-acre workplace, approximately 140 of whom were hams. We have 1,200 people spread over 105 acres and only 10 hams.

Why us?

During an emergency our five security guards cannot provide effective communications over all areas since there are so few of them. Hiring additional security guards just to be able to cover any emergency is expensive. How often would additional security people be needed? How much would it cost to buy hams some HTs and a repeater instead of hiring an equivalent number of security guards? We hams are at work every day and know the layout of our work areas—probably better than the security guards do. Although most of us aren't at work during second and third shift we could be called in to help during off hours.

The advantages of hams providing emergency communications are many:

- We're adept at using the radio to transfer information;
- Once the equipment is paid for the system is nearly free (except for maintenance, equipment upgrades and small amounts of time for meetings, practice, etc.);
- It builds camaraderie among hams at work (we found out that there were two employees most of us didn't know were hams);
- We received free HTs to wear on our belts full-time (what ham doesn't like to wear an HT?);
- Our EPC is planning to get his ham license so he can participate too—the more, the merrier;
- If the emergency is widespread (both inside and outside company property) cellular phones will be jammed, making them useless for emergency communications, so hams will be the only link from the company to the outside;
- The biggest plus is fulfillment of our obligation as amateurs to provide communications as a public service.

Your EPC has what appears to be a very simple job—until an emergency occurs. Then you can really understand the responsibility of the position. Anything that you can do to help him/her during an emergency will be valuable and appreciated.

What are the potential dangers where you work and live? Some are weather-related, others are common to any facility with production/test laboratory areas. Here in South Bend, Indiana, at the extreme northern tip of the state, we have more than you might think.

How's the weather?

Every spring, summer and early fall we have severe lightning storms. What would happen if lightning struck a building, possibly setting it on fire? There would be a need to evacuate the building (in the rain).

Every winter we have one or two blizzards with accompanying "lake effect" snow. Being at the southeast edge of Lake Michigan, we get "dumped on" whenever winds come across the lake

from the northwest. One inch per hour isn't uncommon. A quick buildup of snow could collapse roofs, trapping people inside. We would need to know how many people were trapped as well as keep others out of the hazardous area.

On April 12, 1996, we had a hailstorm that did millions of dollars' damage to cars, homes and crops. What damage could have occurred to our facility? We don't know since the hailstorm hit approximately 10 miles away. We only got a few grape-sized hailstones at our facility while the worst-hit areas received nearly baseball-sized hail.

In September 1985, a tornado touched down about two miles north of our facility at 4 p.m., when most people were leaving to go home. The tornado ripped the roofs off a few homes and then went back into the clouds. (The strange part is that the weather bureau, less than a mile from the point of touchdown, never saw it—nor was a tornado warning/watch issued!) In April 1965 over 200 tornadoes hit the midwest—some of them hit only 20 miles southeast of our city. If you've ever seen what a tornado does to anything in its path, then you know how dangerous they can be to humans.

We have a saying in town: "If you don't like the weather, just wait a few minutes ... " [By the way, northern Indiana really is a very nice place to live. We have beautiful spring, summer and fall seasons—and winter, if you like it. One thing we *haven't* had (yet) is an earthquake.]

Where's the fire?

Any building can catch fire. Getting all the people out can be a real problem. Who might still be inside? Are there winds that might spread the fire to other buildings? We have production and test laboratory areas at our facility. Chemicals could get spilled and catch fire. Smoke from the chemicals could injure someone. We would not only need to get people out of certain areas but keep others from entering those areas.

Man-made hazards

Like many large facilities we have overhead power lines coming into our facility. Our power lines pass over an internal driveway/walkway. Every winter and spring we have at least one or two ice storms. Will the lines stay up if they get coated with ice and the wind picks up? If the lines come down you will need to spread word to all people to stay clear of this area. The affected area will need to be barricaded.

We have railroad tracks less than 200 feet from one of our buildings. In 1992 a tank car on a passing train began leaking ammonia gas. They stopped the train near the building I work in. Luckily, it happened before most people came to work for first shift. Only the security guards and a skeleton third shift were at work. The local radio and TV stations spread the word on the news that morning that all employees were not to report to work until after the area was cleared. What would have happened if the leak had occurred a few hours later when everyone was at work?

In one of our buildings we use jet fuel for testing. If a fire should occur, automatic detectors set off an automatic fire extinguishing system. Sirens sound for 20 seconds and then the area is filled with CO_2 to starve the fire of oxygen. The CO_2 will also asphyxiate humans.

These are examples of the many things that could happen at your facility. These disasters could happen anywhere. Ask your EPC what could happen at your facility and what the communications needs would be for each situation.

Procedures

What kind of information will you transfer from one site to another? You could be letting the command center know any one of the following pieces of information:

- How many people are at your rally point during an evacuation
- How many people are injured, what types of injuries, etc.
- Extent of the damage
- How many people are or might still be trapped inside a building

We were each issued a green construction-type hard hat to wear during both practice drills and real emergencies. The color green stands out so that the emergency coordinators (who wear blue hats) for each area will be able to pick out the communications person (ham) in a crowd of people. We have also put the word "COMMUNICATIONS" on the front of each hard hat. Inside our hats we've each stuffed a copy of a map showing each of our rally point locations. (A rally area is where people go if a building must be evacuated. Although your EPC should pick the rally points, command center, shelter locations, and evacuation routes, your group can certainly help find the best locations. You probably know your building as well as anyone else, so help make the selections if you can.)

Our rally point locations are referred to as A, B, C (Alpha, Bravo, Charlie), etc. Since we only have 10 hams we didn't have any problem with running out of one-letter designators. We purposely did not use our callsigns or names when referring to a rally point. During an emergency you want a very simple way of specifying a location. You don't want to have to determine a location by having to associate a person's call or name with it. Each ham knows approximately how many people to expect at his rally point during an evacuation. We have one ham and one to seven Emergency Coordinators assigned to each rally area. There is also one ham located at in the command center who funnels all the information to our EPC. The command center has a radio on the security department's frequency.

Our command post is the location where our EPC will be during an emergency. It is mobile—two situations that would require the command post to be moved are shifting winds during a chemical leak or fire; and fire department trucks, ambulances, etc., needing access to a given location.

Hopefully your company's management will be as willing as ours to allow you time to spend organizing and practicing your procedures, having meetings, etc. Our company was very generous and allowed us time to get the process organized and in place. We use charge numbers to track the amount of time spent on any given work-related project, this one included. If your company is like ours, get an account (charge number for us) set up so that you can track how much time you really spend putting a system like this in place.

Most of the hams in our group have pagers. Since we may be just about anywhere in one of several buildings we make good use of them for business purposes. They could also be used to spread the warning to all the hams in your group, since we may not always have our HTs with us, but we'll always have

our pagers. You could also have a specific code to send out for each emergency situation—or keep it simple and just have one numeric code, that tells you to check in on the repeater.

You should also consider how you will need to interface with the local police, fire and HAZMAT departments, if and when they come to your facility for an emergency such as a fire, chemical spill, explosion, etc.

Plan what nearby repeater or simplex frequency you will use if your repeater doesn't work (for whatever reason—the antenna gets taken out by wind or lightning, the repeater is being jammed and times out, the power goes out and the battery fails, etc.). Check out coverage using both the alternate repeater and the simplex frequencies. Are there any dead spots?

The first thing we did was to perform a site survey to see if there were any dead spots in our facility. There are several areas that have either lots of metal piping, metal walls or rebar-reinforced concrete walls. While the repeater transmitter can be made as powerful as needed to saturate all areas, the HTs cannot since they have 5W maximum output and the typical "rubber ducky" antenna—a known poor performer!

For the site survey we used 2W HTs, a 1/4-wave vertical mounted atop a three-story building at the center of our facility, and a 10W transceiver with an S-meter. (The S-meter was needed so we could make accurate comparisons of signal levels at all locations.) We walked through all areas while talking to the base station. Levels from all 28 areas checked were very good (nearly full scale: 9) to excellent (full scale: 10) with the exception of one area. A chart was made listing signal level vs. location (see **Table 1**). The received signal at all locations was full quieting. At this point we knew a 10W repeater and 2W HTs would provide the required coverage. When using a repeater, cavities and a better antenna, received signals will be even stronger. (The repeater has more tuned circuits and better sensitivity than the transceiver, the cavities provide additional noise and interference rejection and the antenna has 9dB gain over the simple 1/4-wave antenna used during the site survey.)

When the radios came in, we checked them out and then logged them in a book showing which unit belonged to whom by serial number. Then we each put our callsign on the backs of the HTs. Knowing you are responsible for a particular unit makes you take better care of it.

10W base with ground plane on top of Plant 26
All portables approximately 1.5 – 2.5W
Signal Levels: **1** = none, 3 = poor, 5 = good, 10 = excellent

Location	Signal Level
Plant 14 cell 1	9
Plant 14 cell 2	9
Plant 14 2nd floor east	10
Plant 14 2nd floor west	10
Plant 14 cell 32	7
Plant 14 cell 35	9
Plant 14 cell 7	10
Plant 14 cell 3	9
Plant 14 cell 43	10
Plant 13 south	10
Plant 13 center	10
Plant 2 Gate 6	10
Plant 2 Gate 5	10
Plant 3A	9
Plant 3 Gate 8	10
Plant 3 center	10
Plant 4	9
Plant 5	8
Plant 25	8
Gate 9A	9
MIS	9
HSE	10
Dock 10	10
Plant 23	9
Parking Lots (all)	10
Plant 19 isle	10
Plant 19 west	9
Guard Shack	10

Table 1. *Signal levels on 147.42MHz. Note that Plant 14 cell 32 had the lowest signal level. It was the closest to the base station (only 100 feet away!), while the farthest point (Plant 2 Gate 6, 1,000 feet away) registered very strong signals.*

Our EPC initially asked all of us if we could supply our own radios. About half of us had HTs, several of which did not work reliably. Some were older models and thus were considerably larger and heavier than HTs that are popular now. We need the equipment to be in good working order and most importantly, reliable. We were offered new HTs and our own new repeater system based on the following justifications:

•All hams should have the same radio. If we had to borrow one from another ham in our group, the borrower would already be familiar with the operation of the radio.

•The radio will always be at work. There won't be any problems with having to remember to bring your radio to work each day. There is always the risk of dropping your own HT or banging it into something while going in and out the entrance, carrying it in your car, etc. Keeping it at work will eliminate this possibility.

•The radios are new and should be trouble-free for at least a few years. The part that will probably need replacing first is the battery pack since the heat from the drop-in charger will shorten its life. (A tip: cycle your battery periodically to keep it healthy and do a check on it so it gets replaced b*efore* it fails during an emergency.)

You will need to coordinate with your state's repeater frequency coordinator to get your frequency assignment. Your antenna pattern should provide good coverage throughout the entire facility. The best location for our antenna was not in the center of our facility but rather far off center. With the antenna being much closer to some locations than others we focused most of the power to the farthest areas. This has the extra benefit of keeping our signal out of the coverage area of other repeaters, and keeping their signal out of our repeater. Try to put the antenna's major lobe and null where they will do the most good.

Problems and solutions

We have 10 hams to cover approximately 105 acres and 1,200 people. The

ratio of 10.5 acres and 120 people per ham results in much more responsibility for each ham at our facility. (Compare our ratio with the 58 people and 1.5 acres per ham at Rockwell.) What's the solution? Get more people at our facility to get their ham licenses! We already have our EPC interested in getting his ham license.

The HTs we selected have a rather small speaker that produces very little audio. Will we be able to hear them in a noisy location? Perhaps a speaker-mike would help. I've heard the amount of audio from a Motorola commercial HT and our little TH-22s are no match for the Motorolas! Granted, they cost about five times as much as ours and we probably won't be going into noisy areas with our HTs, but will they be able to produce enough audio for all our needs?

There are a lot of PCs and other electronic equipment throughout our facility. Walking through many areas we get squelch openings caused by the machinery and PCs emitting signals on our repeater frequency. (My own PC at work opens the squelch on my HT, located 10 feet away.) We don't want these squelch openings to occur while we walk through office areas or while in a meeting. The solution is to install PL decoders so that the receiver doesn't open until it hears the PL frequency. However, not thinking far enough ahead, we didn't order our HTs with this option. Going back to request more money is always more difficult than asking for the full amount the first time. Make sure you cover *all* known expenses the first time. Our EPC is not the one reluctant to request more money, but he said it would have been easier to buy all that we needed the first time.

When trying to reach another ham about work-related issues it can be very tempting to use your HT rather than calling him on the phone, paging him on the PA system or calling his pager. Remember that ham radio is *not* to be used for business purposes. If you use the HT to call another ham to discuss ham radio issues, that's fine, but don't use the HT/repeater for anything to do with business matters. Remember, too, that amateur transmissions are *not* private and anyone could be listening. By using phones, pagers or PA systems you are assured privacy. If there is any doubt, don't use the HT.

Our EPC wants our guards to have receivers nearby so they can monitor our transmissions during an emergency. With this receiver on all the time they will hear any casual (ham-related) transmissions, too. Will they turn it down if they consider it annoying and forget to turn it on during an emergency? No solution has been thought of yet.

What happens if your HT is damaged? Our EPC anticipated this situation and has offered to replace/repair our HTs if they're damaged while "on duty." If we take them home overnight or over the weekend and they get damaged, the repair comes out of the ham's pocket. Don't abuse the system. Be honest—if you damage the HT away from work, pay for it.

Don't put autopatch on your repeater! We didn't and will never miss it. We

Photo A. *Mario Meribela N9ABN, David Scott WD8CZM, Brian Dickey KB8QEC, Tony Kostreba KB9AFW, Stephen Elek, Jr. KB9GP, Bob Herendeen N9NRW, Harold Miller N9PEN, Roger Tinti WA9OKC, Jim Kocsis WA9PYH. Not available for photo: Mark Thompson WB8OWQ. Photo by Ben Jagla.*

have telephones all over the facility if you ever need to make a phone call. An autopatch would be more of a problem than it's worth.

If you want to find some more "holes" in your system, try having a practice evacuation. We scheduled one, but the time it would occur was only specified as "sometime during the month of October." Our EPC picked a clear day when it was 70 degrees.

Problems we encountered were significant:

- Several people did not know the location of their department's rally point;
- Only a few of the Emergency Coordinators showed up at their rally points;
- Many of the ECs had never made it to the training sessions they were supposed to attend, so they didn't know what to do during the evacuation;
- Many employees did not know who their EC was.

Keep in mind that you are stopping production to test the system—management doesn't want to have to practice very often (not at all, if possible), so make sure you get most, or all, of the faults identified with one practice evacuation.

The repeater caused us some problems too. It turned out that the repeater we bought is available in two models. One covers 134 to 146MHz, the other 146 to 160MHz. The dealer didn't tell us that the units cover either the upper or lower 2MHz of the 2m band, but not both. It turned out that we ordered the right model, but what if we had received a frequency allocation in the opposite 2MHz? Back to the dealer goes the repeater; add a few weeks' delay. (The repeater we chose is synthesized and can be set up on any frequency in its range. However, the unit has capacitors and coils in the front end that are different for the two different frequency ranges. The parts that need to be changed are surface-mount parts, something that we didn't want to change, since they are rather difficult to solder. Also, the warranty would be voided if we modified the unit.)

The equipment

We chose Kenwood's TH-22ATH for the HT, a Yaesu VXR-5000 25W repeater, Cushcraft AFM-4DA bay antenna, Communications Specialists model ID-8 CW identifier, Wacomm model WP639 VHF-FM cavities, a temperature compensate battery charger, Xenotrix model 8110F12100CN/P, a Yuasa/Exide 65Ah battery, Belden 9913 coax and a few type-N coax connectors. The total cost for all this equipment was $5000. Call around for quotes for the brands you choose. We had problems interfacing the identifier to the repeater. See if you can get a repeater that offers either a built-in identifier or one that plugs right in. Several of our guys spent a whole afternoon getting the repeater and IDer to work together properly.

Credits for a job well done!

Here are the guys who did the bulk of the work getting our system in place:

Mario N9ABN used a PC to program the repeater transmit/receive, timeout time, PL on, PL frequency; compiled the site survey data.

Roger WA9OKC aligned the repeater receiver for maximum sensitivity, assembled the antenna, loaned us his spare cavities until ours came in and provided/operated the transceiver/antenna for the site survey.

Bob N9NRW gathered the quotes for the equipment, coordinated with the purchasing department to get the equipment ordered, programmed and interfaced the IDer, and took the role of repeater licensee.

Tony KB9AFW checked out all the HTs upon arrival, tracked all HTs by serial number and assigned them, figured out how to program the HTs and the options (group paging, etc.) that we might use in the future.

Others provided moral support.

Consider approaching your EPC to see if he thinks you could provide help with a system like this. You will probably want to meet among yourselves before you approach your EPC since you may not get the support of enough hams or might have some big stumbling block that will prevent you from succeeding in implementing a system like ours. If you think you have enough hams to be of some help, go to the safety people and lay out your plans. Keep in mind that companies exist to make money and their first question will probably be "How much will it cost?" Do your homework and have an approximate dollar amount ready (hopefully a little on the high side) for that first meeting.

Also consider getting in touch with your local newspaper to see if they will carry an article showing the services your group is providing to the community—additional PR in your community never hurts. Good luck! 73

Figuring RF Exposure

New standards can help avoid potential hazards.

Robert Vreeland W6YBT
45 Maywood Drive
San Francisco CA 94127

Volts per meter, amperes per meter, milliwatts per square centimeter: if these terms are not familiar now, they probably will be by the end of the year. At that time, you will be required to conduct an RF safety evaluation for your station.

The experts have been arguing for 30 years about whether there are or are not nonthermal effects from exposure to RF. They still don't agree. One thing they do agree on is that fairly high exposure to RF can cook eyeballs and do other bad things. For this reason, the RF exposure standards are based on the heating effect of RF. If you spend a sunny day at the beach, a certain amount of the sun's power will fall on each exposed square centimeter of your skin. Hence the terms microwatts per square centimeter and milliwatts per square centimeter.

Measuring the heating effect of RF directly can be done with a temperature-sensitive resistor called a bolometer. This technique is practical only at microwave frequencies, however. At lower frequencies, the best we can do is to measure the voltage that the electric field will induce in a dipole or that the magnetic field will induce in a loop. The units of measurement are volts per meter for the electric field and amperes per meter for the magnetic field. If you could measure one volt between two points one meter apart in space, the electric field strength would be one volt per meter.

Since heating is due to power density, we must convert volts per meter to milliwatts per square centimeter. Ohm's law to the rescue. $P = E^2/R$. If E is 27.5 volts per meter in space, it will be 0.275 volts per centimeter because there are 100 centimeters in a meter. So what about R? It is 376.7 ohms, which is the resistance of free space. So let's solve the equation:

$$P = \frac{E^2}{R} = \frac{(0.275)^2}{376.7} = \frac{0.00020\text{W}}{\text{cm}^2} = \frac{0.20\text{ mW}}{\text{cm}^2}$$

This is the 30 to 300 megahertz limit for uncontrolled environments as specified in the new standard. The standard has been written for both volts per meter and milliwatts per square centimeter so that you won't have to make this conversion. Thanks, FCC. The 1982 standard didn't do this.

If you are fortunate enough to have access to a spectrum analyzer and calibrated antennas, you can measure the field intensity at your station. This is a simple but somewhat time consuming process involving adding a bunch of factors expressed in dB. There is one catch, however. The spectrum analyzer is calibrated in dBm. This means dB relative to one milliwatt in 50 ohms. The antenna, on the other hand, is calibrated in dB relative to one microvolt (dBμV). Again, Ohm to the rescue.

$$P = \frac{E^2}{R} \text{ or } E = \sqrt{PR} \text{ where } P = 1\text{mW and } R = 50\Omega$$

So let's solve the equation:

$$E = \sqrt{PR} = \sqrt{0.001 \times 50} = \sqrt{0.05} = 0.2236\text{V} = 223600\mu\text{V} = 2.236 \times 10^5\mu\text{V}$$

Now 10^5 = 5x20dB =100dB and 2.236 = 7dB.

So we can convert dBm into dBμV by simply adding 107dB.

We now know what dBm and dBμV mean. What about dBc, dBd, and dBi? Harmonics and other spurious signals are measured in dBc, which means dB below the carrier. But how do we know whether this means volts or watts? The answer is neither. It means dB. The decibel is the logarithm of a dimensionless ratio.

As you know:

$$\text{dB} = 10 \log \frac{P1}{P2} \text{ or dB} = 20 \log \frac{E1}{E2}$$

Note that the units (watts or volts) cancel out because they appear in both the numerator and denominator. So dB means dB. We can, however, convert dB into a power ratio or a voltage ratio by using one or the other of the above formulas.

Antenna gain is measured in dBd. This means dB relative to a half-wave dipole. The term dBi refers to gain relative to a theoretical but non-existent point source radiator. It is useful for computing predicted antenna gain, but it should never be used to indicate the gain of a practical working antenna. A half-wave dipole has a gain of 2.14 dBi. Antenna manufacturers sometimes list their antenna gains in dBi because it makes them look 2.14 dB better than they really are.

I hope that I have helped make the commonly used units of RF measurement more understandable. It is not my intention to comment on the new RF safety standards except to say that in my opinion they are both reasonable and enforceable. I leave the experts to continue their arguments for another 30 years. In the meantime I'll continue to carry my 2m HT on my belt and use a speaker-mike to avoid exposing my eyes.

Antennas for Amateur Television, Part 2

See Part 1 in July's 73.

Nizar A. Mullani KØNM
719 Santa Maria
Sugar Land TX 77478
[KØNM@amsat.org]

The corner reflector, invented by John Krauss, is probably one of easiest antennas (next to the cantenna) that a ham can build in a few minutes to get from 10 to 13dB of gain. It is an extremely simple design (**Fig. 1**) in which a reflector, bent into the form of a corner, is used to reflect the radiation from a dipole radiator in the front of the antenna. With proper spacing of the radiator from the corner, the reflected wave adds to the forward wave to increase the gain in the forward direction.

The gain of the corner antenna depends on the angle of the corner, the position of the radiator with respect to the apex of the corner, and the size of the reflector. The gain will vary from 10 to 15dB, depending on the angle of the corner. A gain of 10dB is easily attained for a corner with a 90° angle and 12dB for the 60° corner. Higher gains are attained by using the 45° corner antenna. In **Fig. 2**, the gains of a 90° and 60° corner antenna are shown as a function of the spacing of the radiator from the apex. As can be seen in this graph, the gain of the antenna as a function of the spacing of the radiator within the corner reflector is not that critical for the 60° and 90° corner reflectors, and provides a great means for matching the feedpoint impedance to 50 or 75Ω coax for low SWR. The feedpoint impedance will change as a function of the spacing of the radiator from the corner, as shown in **Fig. 3**. It is easy to see that moving the radiator in and out slightly can improve impedance matching.

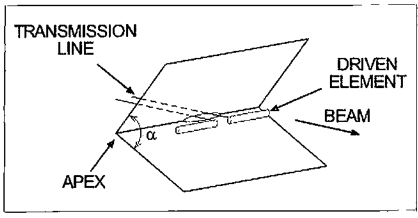


Fig. 1. The corner reflector (Ref. 2, p. 551).

The size of the reflector will determine the overall gain of the antenna. The width of the reflector should be a minimum of 0.6 wavelengths long. Width-of-one-wavelength reflectors will improve the gain slightly in the forward direction and minimize radiation from the sides. The length of the corner is also not supercritical, but shorter than one-wavelength-long corners have a tendency to broaden the radiation pattern and reduce the gain. Therefore, a minimum of one-wavelength-long corner is recommended for the 90° angle corner; longer for the 60° and 45° corners. The reflector material can be made out of wire elements, mesh, or sheet metal. If wire elements are used, the separation between these elements should not be greater than 0.1 wavelength. Shorter spacing, such as 0.05 wavelength, is more desirable. Mesh size should be approximately 0.05 wavelength on square.

A set of dimensions that have been worked out for the corner reflectors for the VHF and the UHF range is shown in **Table 1**. Several different options have been presented in this table, and you can refer to **Fig. 4** for an explanation of different dimensions in the corner antenna. Broadband operation of the corner reflector can be achieved by using a bow-tie dipole radiator instead of the single-element dipole.

The corner reflector has some great advantages, in that it is probably one of the simplest to build, is simple to feed, and can be used for multiple bands. It is possible to add a second radiator for the higher bands within the corner reflector and drive the two radiators with separate coax. This way, a dual-band operation can

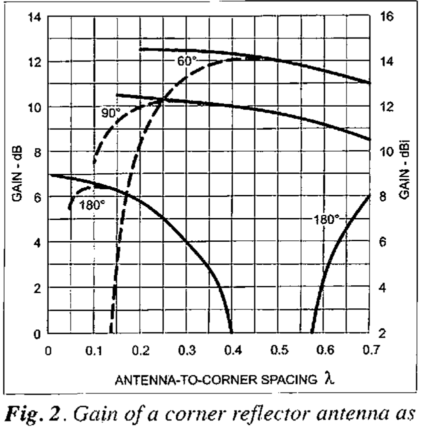


Fig. 2. Gain of a corner reflector antenna as a function of the spacing of the dipole from the reflector (Ref. 2, p. 554).

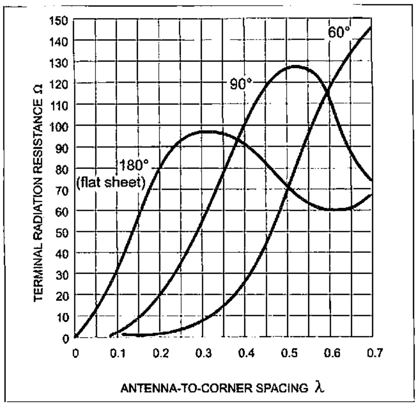


Fig. 3. Feedpoint impedance of the radiating dipole in a corner reflector antenna as a function of the spacing between it and the reflector (Ref. 2, p. 556).

be achieved within the same reflector. The disadvantage of the corner reflector is that its physical size becomes large, especially at the lower frequencies.

The trough reflector antenna

The gain from the corner reflector is typically limited to approximately 13dB or so with the size of the reflectors applicable for ATV. Additional gain can be obtained by making the reflector larger, and one design which achieves this without making an unwieldy corner reflector is the trough reflector. In this design, the apex of the corner is truncated so that the reflector becomes flat immediately behind the radiator, with sides that are angled at the original corner angle. The shape of this reflector is like a feed trough for cattle, so it's called the trough reflector.

The design of the trough reflector is shown in **Fig. 5**. The dimensions of this antenna become quite large at the 400MHz frequency but are manageable from 900MHz and up. Typical gains of 15 to 17dB can be obtained with this antenna. It is similar to the corner reflector, in that it is easy to build and feed, and also offers the possibility of multiband operation. The disadvantage of the trough reflector is that its size becomes quite large at the lower UHF frequencies. An additional disadvantage is that as the gain is increased, the beamwidth is decreased in one direction. Therefore, a very narrow beam is obtained in one direction while a broad beam is obtained in the other direction.

Dimensions for Corner Reflector Arrays (VHF and UHF)

Frequency (MHz)	Side Length S (inches)	Dipole to Vertex D (inches)	Reflector Length (inches)	Reflector Spacing G (inches)	Corner Angle (V°)	Radiation Resistance (Ohms)
144*	65	27 1/2	48	7 3/4	90	70
144	80	40	48	4	90	150
222*	42	18	30	5	90	70
222	52	25	30	3	90	150
222	100	25	30	Screen	60	70
420	27	8 3/4	16 1/4	2 5/8	90	70
420	54	13 1/2	16 1/4	Screen	60	70
915	20	6 1/2	25 3/4	0.65	90	70
915	51	16 3/4	25 3/4	Screen	60	65
915	78	25 3/4	25 3/4	Screen	45	70
1296	18	4 1/2	27 1/2	1/2	90	70
1296	48	11 3/4	27 1/2	Screen	60	65
1296	72	18 1/4	27 1/2	Screen	45	70
2304	15 1/2	2 1/2	20 1/2	1/4	90	70
2304	40	6 3/4	20 1/2	Screen	60	65
2304	61	10 1/4	20 1/2	Screen	45	70

*Side length and number of reflector elements somewhat below optimum; slight reduction in gain.

***Table 1**. Dimensions of corner reflector arrays for VHF and UHF (Ref. 1, p. 18-10).*

The reflex antenna

An antenna that has high gain, is easy to build and operate, but is not very well known, is the reflex antenna. Basically, this is a shallow sheet metal box, approximately two wavelengths long on each side and one-half wavelength deep. A dipole radiator is placed in the center of the box at a distance of approximately one-quarter wavelength from the back of the sheet reflector. A set of wire elements spaced about one-half wavelength apart are placed at the front of the box reflector, and help to reflect back the radiation at high angles. This design is shown in **Fig. 6** with dimensions for 440MHz and 1250MHz antennas. Gain of approximately 12dB is easily attained and higher gains can be achieved with larger-sized boxes. The advantage of the reflex antenna is that it is simple to build and easy to feed. The disadvantage is the large size of the reflector—which makes it difficult to mount on a tower.

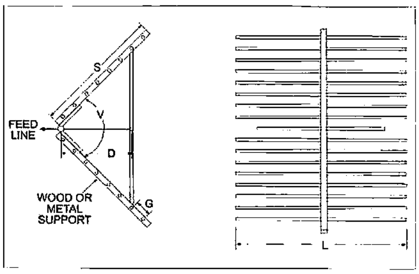
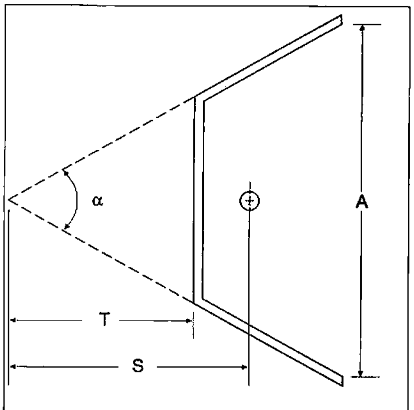


*Fig. 4. Design of the corner reflector and the parameters used in **Table 1** (Ref. 1, p. 18-10).*

The parabolic reflector

The parabolic reflector is probably one of the most powerful reflecting antennas used in microwaves. It is used extensively in optics as a high-efficiency reflector for narrow-beam projection of light, such as in a flashlight. Its principle



Angle α	S(max gain)	Gain	T
90°	1.5λ	13 dB	1λ-1.25λ
60°	1.75λ	15 dB	1.0λ
45°	2.0λ	17 dB	1.9λ

Fig. 5. The trough antenna and some of the general parameters for its design (Ref. 1, p. 18-11).

of operation is quite simple: For a radiator at the focus of the reflector, the reflected radiation from the radiator travels the same distance to the front of the antenna regardless of which location it reflects from in the antenna reflector. This means that all of the radiation reflected from the parabolic reflector is in phase at the surface of the reflector, and becomes additive to produce the gain in a forward direction. The shape of the reflector that achieves this is paraboloid, as shown in **Fig. 7**.

The radiator is usually placed at the focus of the ray paths of the signal. The design of the radiator is quite critical in the proper operation of the parabolic reflector and proper illumination of the reflector is critical to achieving high gain. Isotropic radiators send only part of the radiation back toward the reflector while radiating some to the front. Radiators with reflectors in the front, such as a dipole with a reflector, reflect the signal back toward the parabolic reflector to illuminate the reflector better.

Very effective for the parabolic reflector is the cantenna design, with a shorter can length, so as to illuminate the surface appropriately. The beamwidth of the radiator is critical so that the maximum energy is delivered to the full surface of the reflector. A very narrow beamwidth will only concentrate the energy in a certain part of the reflector and not the full surface. Similarly, a very broad radiator will tend to put the radiation outside of the reflector and decrease the gain. A rule of thumb used by several designers of parabolic reflectors is to reduce the signal level at the edge of the parabola by 10dB from the center. Feeding the parabolic reflector with other than horizontal or vertical polarized radiation is easily achieved with a short helical winding radiator for circular polarization.

The gain of the parabola is a function of its diameter. **Table 2** shows a typical range of gains for the diameter of the dish antenna and the frequencies. As the frequencies increase, the variations on the surface of the dish antenna and the deviation from parabolic surfaces become critical. This makes it difficult for the average amateur radio operator to construct his own parabolic reflector, but parabolic reflectors are abundant in

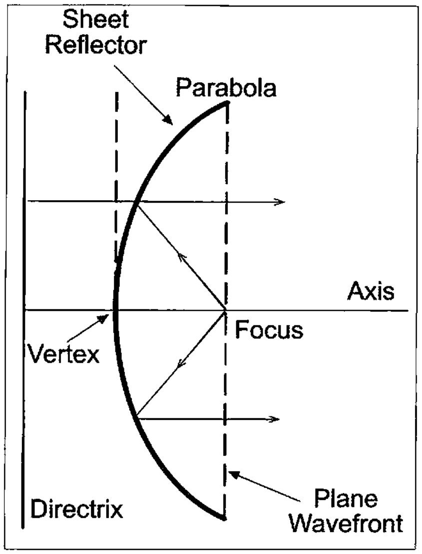


Fig. 7. The parabolic (dish) reflector antenna and the ray path of the reflected waves showing the in-phase reflected wave (Ref. 2, p. 562).

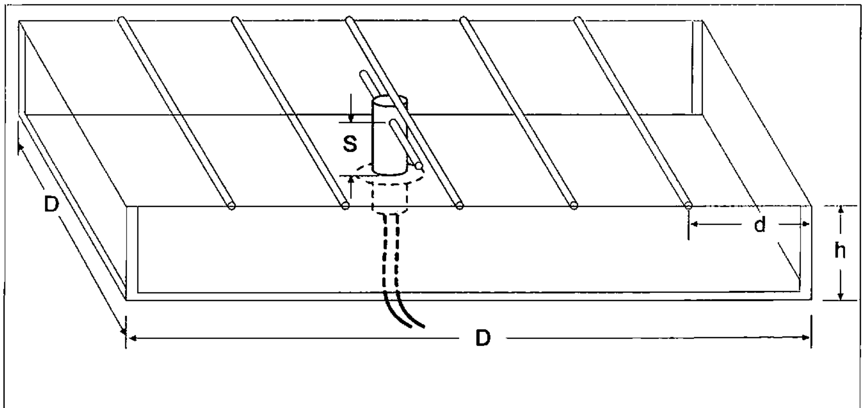
the surplus market, so an antenna can be easily built for the ham frequencies.

The advantage of the parabolic reflector is its extremely high gain. Gains of approximately 20 to 30dB can be easily achieved with a properly designed dish antenna. The disadvantages of the parabolic reflector are: the difficulty in making a precision reflector; illuminating it properly with the proper radiator; and its large size for the lower bands.

The horn

The horn antenna is a waveguide that is flared out into a horn with a wide opening. The angle of the horn, its size, and its aspect ratio will determine the gain and polarization of the radiation. Horn antennas have one very important characteristic: They are essentially high-pass devices, which means that they can work at frequencies that are higher than the design frequency. A horn designed for 400MHz will work all the way up to 10GHz and its gain will increase as the frequency is increased.

The horn, adapted for single polarization, is shown in **Fig. 8**. Instead of a full metal pyramidal structure, only two sides are used and the polarization is horizontal. The feedpoint impedance is approximately 400Ω and open-wire transmission lines can be used to reduce the line losses. Alternatively, a step-down transformer can be used to match into 50 or 72Ω coax. This antenna will work from 400MHz to 2.4GHz, will



BAND	D	S	h	d	Rods Diam	Dipole Length	Dipole Diam.
440MHz	30"	7.5"	12"	7.5"	.5"	12.5"	.25"
1250MHz	18"	2.5"	4"	2.5"	.156"	4.25"	.125"

Fig. 6. The reflex antenna and design parameters for the two useful frequencies for ATV. Gains of 10 to 12dB are easily achieved with this design (Ref. 3, p. 404).

Parabolic Antenna Gain

(over isotropic antenna; subtract 2.1 dB for gain over dipole antenna)

	Dish Diameter (feet)						
	2	**4**	**6**	**10**	**15**	**20**	**30**
Frequency							
420 MHz	6.0	12.0	15.5	20.0	23.5	26.0	29.5
902	12.5	18.5	22.0	26.5	30.0	32.5	36.0
1215	15.0	21.0	24.5	29.0	32.5	35.0	38.5
2300	20.5	26.5	30.0	34.5	38.0	40.5	44.0
3300	24.0	30.0	33.5	37.5	41.5	43.5	47.5
5650	28.5	34.5	38.0	42.5	46.0	48.5	52.0
10 GHz	33.5	39.5	43.0	47.5	51.0	53.5	57.0

Table 2. Gain of parabolic antennas. Reflector efficiency of 55% is assumed (Ref. 1, p. 18-12).

have significant gain at the higher frequencies, and is an excellent antenna for reception of several ATV transmissions on different frequencies.

With the exception of the parabolic reflector antennas, most of the antennas referred to in this article can be built within a couple of hours, and gains between 10 and 13dB can be easily achieved. The yagi is a proven antenna which can deliver high gains when designed and constructed properly. The cantenna, the corner reflectors, and the reflex antennas are noncritical designs, very forgiving in their construction. They are probably the easiest high-gain antennas that can be built for ATV by the average amateur. The parabola remains the ultimate high-gain antenna, unmatched in performance at the higher frequencies, with gains exceeding 20dB.

References

1. *The ARRL Antenna Book*; ARRL Publications, Newington CT, 1994.
2. *Antennas* by John D. Krauss, 2nd Edition; McGraw-Hill International, New York NY, 1988.
3. *The Amateur Radio Handbook*, 3rd Edition; Radio Society of Great Britain, London, 1961.
4. *Radio Handbook* by William Orr, 18th Edition; Editors and Engineers Ltd., Indiana, 1970.

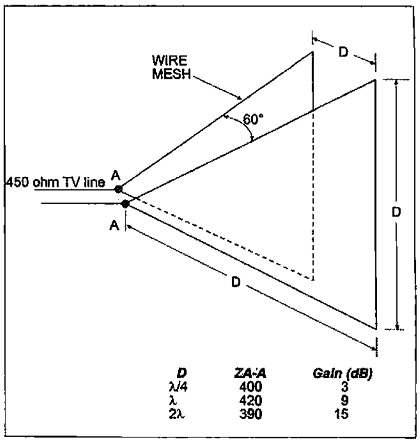


Fig. 8. A 60° horn antenna design for horizontal polarization of signal. The two sides are made of wire mesh or sheet metal and placed at an angle of 60°. Feedpoint impedance is approximately 400Ω and the antenna will operate at higher frequencies than the design frequency (Ref.4, p. 543).

Negative Resistance RF Preselector

An easy way to soup up that old superhet.

Parker R. Cope W2GOM/7
8040 E. Tranquil Blvd.
Prescott Valley AZ 86314

Interference, from whatever source, is the bane of the radio receiver user. Some interference is on the same frequency as the desired signal, and there's not much that can be done about that. But there's hope for eliminating or at least reducing off-frequency interference with RF selectivity.

Off-frequency interference falls into two general categories: strong signals that drive the receiver into nonlinear operation and produce intermodulation distortion or cross-modulation, and spurious receiver responses. RF selectivity can reduce the amplitude of the interfering signal to tolerable levels. The rub comes in the selectivity that can be achieved with practical and economical tunable tuned circuits. Narrow bandwidths require high-Q tuned circuits, and the Q tops out at about 100 for practical inductors suitable for HF receivers.

All is not lost, though. The circuit described in the following paragraphs can increase the Qs of a tuned circuit to more than 1,000 if need be. The theory and design equations are given to allow changes to be made to accommodate a particular situation or the parts at hand.

Receivers fall into two general classes: tuned radio frequency (TRF) and superheterodyne. The TRF is conceptually simple and free of spurious responses. Unfortunately, it is not very selective. A crystal set is a TRF without RF amplifier(s), although it may have post-detection audio amplifiers.

The superhet receiver converts the input RF signal to a frequency that permits greater selectivity. It offers many advantages, but at a price: it has spurious responses. The process of converting the desired signal to the IF produces two signals that can be received equally well. One is the IF above the local oscillator, and a second one is the IF below the local oscillator. These two responses are separated by twice the IF; one is the desired signal and the other is the image.

Rejecting the image response is a primary concern in superhet receiver design. When the IF is low, the image and the desired frequency are close together and it is more difficult to suppress the image. There have been two primary solutions to rejecting the image. One is to use one or more RF amplifiers in front of the first mixer for improved RF selectivity; the other is to use two (or more) IFs. In the dual conversion receiver, the first IF is made high enough to ease image rejection, and the second made low enough to make selectivity manageable. The multiple conversion receiver is more complex, but enjoys greater popularity today than the single conversion types.

The single conversion receiver usually has an IF in the range of 455kHz, with the local oscillator operating above the desired frequency. This arrangement puts the image 910kHz above the tuned frequency. Tuning to 550kHz in the broadcast band puts the image at 1460kHz, which is also within the broadcast band and makes image suppression critical.

The five-tube AC/DC receivers of the '40s and '50s had only one tuned circuit between the antenna and the first mixer. In inexpensive receivers, a single conversion is used and image response is often sacrificed on the altar of cost. Some inexpensive shortwave receivers also used the same design concept. Needless to say, they received lots of signals, but half of them were images.

Using RF amplifier stages between the antenna and the converter is effective in suppressing the image. Each RF stage increases off-frequency suppression by 6dB. The number of sections in the tuning capacitor indicates how many RF stages there are: one section (the smallest) for the oscillator; one section for the antenna; and one for each of the RF stages. A three-section capacitor indicates one RF stage.

An image response down 30dB from the tuned frequency is pretty good, but nothing to brag about. A receiver with a single RF amplifier can provide fair image suppression for tuned frequencies up to 7MHz. Above 40m, the performance falls noticeably. A shortwave receiver without an RF amplifier will have serious image responses at 40m and can be questionable even in the broadcast band. If only reliable, high-Q RF circuits were available ...

The response of one single-tuned stage falls 6dB for every doubling of the

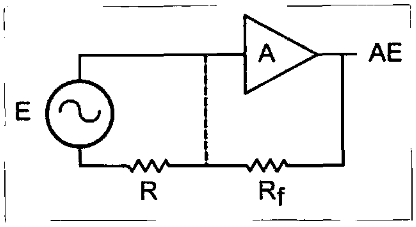


Fig. 1. A conceptual negative resistance generator.

bandwidth. Therefore, when the response is down 30dB, the bandwidth is 32 (2^5) times the 3dB bandwidth. To have a frequency (the image) 910kHz off-frequency be down 30dB requires the 3dB bandwidth to be about 28.5kHz. A tuned circuit with a Q of 60 at 7MHz has an equivalent parallel resistance of about 69k and a bandwidth of about 117kHz. A bandwidth of 28.5kHz requires a Q of about 246.

The bandwidth of a parallel-tuned circuit is related to the circuit Q as follows:

$$BW_3 = \frac{f_o}{Q} = \frac{1}{2\pi C R_p}$$

where

BW_3 = the 3dB bandwidth in Hz

f_o = the center frequency in Hz

$$Q = \frac{R_p}{X_L} = 2\pi f_o C R_p$$

C = the circuit's resonating capacitance in pF

R = the equivalent parallel resistance in Ω

When the tuning capacitance is 20pF, a bandwidth of 28.5kHz requires a parallel resistance of about 280kΩ. This parallel resistance is much higher than that of any practical inductor. But, adding a negative resistance across the resonant circuit increases the effective resistance as well as the Q.

A negative resistance is not a component you can buy from your local electronics supplier, but it is something you can generate with a simple circuit. A conceptual negative resistance generator is shown in **Fig. 1**. R is the total resistance appearing at the input of the amplifier, the effective parallel resistance of the source and the input resistance of the amplifier. The gain of the amplifier is A and the output is in phase with the input. R_f provides feedback from the output of the amplifier back to R.

When the junction of R and R_f is removed from the amplifier in **Fig. 1**, the open circuit voltage of the source E appears at the input of the amplifier and its output is AE. Since the same current flows in R and R_f, when the voltage across R is E, the voltage across R_f must be AE-E or E(A-1). When the value of R_f is chosen so that the voltage across R is E, R_f/R = A-1. When the voltage across R is E and the junction of the resistors is reconnected to the input, no current flows from the source into the resistors. The resistance looking into the junction of the resistors is infinite, and the conductance looking into R_f is exactly equal to the negative conductance of R.

$$R_n = \frac{R_f}{(A-1)}$$

A practical noninverting RF amplifier is shown in **Fig. 2**. The gain of the amplifier is determined by the transconductance of the pair of transistors, G_m, R_s, and the ratio of R_c to R_s. The gain may be expressed as:

$$A = VG_{sf}\left(\frac{1 + R_c}{R_s}\right)$$

VG_{sf} is the voltage gain of the source follower. The gain of a source follower is often assumed to be unity when, in fact, it is always somewhat less than that.

The gain of a source follower is:

$$VG_{sf} = \frac{G_m R_s}{(G_m R_s + 1)}$$

The gain is near unity only when the product $G_m R_s$ is much greater than one. G_m is the change in the current in R_s for a change in gate voltage. The current in R_s is essentially I_c. Since $I_d = I_b$, and $I_c = I_b h_{fe}$, G_m can be expressed as:

$$G_m = g_{fs} h_{fe}$$

The N-channel JFET, Q1, is a 2N5457. It is similar to the MPF102, but has some typical values given in the data sheet whereas only maximum and minimums are given for the MPF102. Typical values for the 2N5457 are: I_d = 0.1mA for V_{gs} = 2.5V; I_{dss} = 3.0mA for V_{gs} = 0V. V_{off}, the gate to source voltage that reduces I_d to zero, is given in the data sheet as 0.5V minimum to 6V

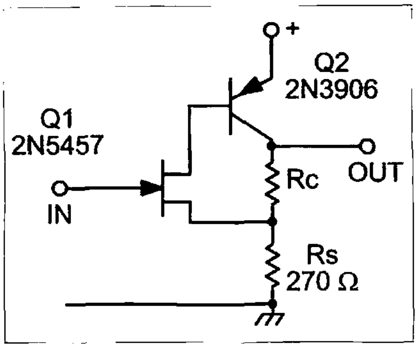


Fig. 2. A practical noninverting amplifier.

maximum. V_{off} must be either measured or calculated for use in calculating I_d and g_{fs}. The relationship of I_d to I_{dss}, V_{gs}, and V_{off} is:

$$I_d = I_{dss}\left(\frac{1 - V_{gs}}{V_{off}}\right)^2$$

This may be rewritten to solve for V_{gs}/V_{off}:

$$\frac{V_{gs}}{V_{off}} = 1 - \sqrt{\frac{I_d}{I_{dss}}}$$

which can be rewritten to solve for V_{off} or V_{gs} for the typical values of V_{gs}, I_d, I_{dss}:

$$V_{off} = V_{gs}/\left[1 - \sqrt{\left(\frac{I_d}{I_{dss}}\right)}\right] = 3.06\text{V}$$

$$V_{gs} = V_{off}\left[1 - \sqrt{\left(\frac{I_d}{I_{dss}}\right)}\right] =$$

2.66V (for I_d = 0.05mA)

The forward transconductance of Q1, gfs, can be calculated with the expression:

$$g_{fs} = \frac{2I_d}{(V_{off} - V_{gs})} =$$

2.5×10^{-4} (I_d = 0.05mA)

The ratio of collector current to base current, h_{fe}, of Q2 (2N3906) is assumed to be 200 (specified as 100 minimum, 300 maximum at I_c = 10mA). Since I_c is very much greater than I_d, the current in R_s is essentially I_c. To produce V_{gs} = 2.66V (I_d = 0.05mA, I_c = 10mA), R_s must be 266Ω. 270Ω, the nearest standard 5% value, is used for R_s. The effective transconductance G_m is:

$G_m = g_{fs} h_{fe} = 0.25 \times 10^{-4} \times 200$ = 0.05mhos

The voltage gain of a source follower is calculated with equation 5 to be 0.93:

$$VG_{sf} = \frac{G_m R_s}{(G_m R_s + 1)} = 0.93$$

The gain of the amplifier can now be calculated with the equation

$$A = VG_{sf}\left(\frac{1 - R_c}{R_s}\right)$$

for the values of VG_{sf} and R_s established. Rearranging the equation to solve for R_c yields:

$$R_c = R_s\left(\frac{A}{VG_{gs} - 1}\right)$$

The negative resistance is controlled by A and R_f. If the resistance across a tuned circuit is 69k and the resistance needs to be 280k for the desired bandwidth, the negative resistance needed can be determined as follows:

$$\frac{1}{R_{desired}} = \frac{1}{R_{tank}} + \frac{1}{R_n}$$

$$\frac{1}{280k} = \frac{1}{69k} + \frac{1}{R_n}$$

$$\frac{1}{R_n} = \frac{1}{69k} - \frac{1}{280k} = \frac{1}{91k}$$

The equation

$$R_n = \frac{R_f}{(A - 1)}$$

shows that a 91k negative resistance can be generated with R_f of 91k and an amplifier gain of 2.0, or when R_f is 150k an amplifier gain of 2.6 is required. Given the uncertainty of the Q of the tuned circuit, it seems prudent to make the gain variable by varying R_c. Changing R_c does not change the operating point of the amplifier as long as Q23 does not saturate. That is, as long as V_{ce} is greater than 1V.

The DC operating point of the amplifier is determined as $R_s I_c$. Since I_c is independent of collector voltage while V_{ce} is greater than V_{cesat} and I_d is independent of V_{ds} while V_{ds} is above pinch-off, the operating point is independent of the supply voltage. The operating point is determined by R_s and I_c. The high negative feedback leads to a very stable amplifier. If I_c tried to rise, V_{gs} would rise, I_d would decrease and I_c would decrease.

The amplifier shown in **Fig. 3** has R_c composed of 300Ω fixed and 500Ω variable. The gain varies from 2.0 to 3.8. When R_f is 91k, R_n will be variable from 91k to 33k. While the negative resistance can be controlled with either A or R_f, it is preferable to have the gain low because a lower R_c results in greater bandwidth of the amplifier and smaller DC voltage drop across R_c, which will reduce the DC power supply voltage requirements.

The power supply for the negative resistance generator is not critical; the only requirement is that the voltage be high enough to keep the 2N3906 out of saturation when R_c is maximum. The DC voltage, collector to ground, can be as high as 14.4V with worst case component values, which translates into a supply voltage of about 15.2V. The maximum VDG (drain to gate) of the 2N5457 is given as 25V. Therefore, the supply voltage can be anything from 15.2V to 25V. The current drawn is about 10mA (12mA worst case) which can probably be stolen from the receiver's supply without ill effects.

The negative resistance generator can be built on a one-inch-square perfboard that fits nicely on the RF (antenna) section of the tuning capacitor. Bandswitching usually entails switching coils, and the Qs may vary from band to band and with frequency over a band. Therefore, the selectivity control R_c should be convenient to adjust when tuning. For maximum bandwidth, the leads from R_c should run directly to the circuit board and not be dressed into a harness or against the chassis.

It is worth noting that if the total resistance across the tank is negative, the circuit will have infinite Q and will oscillate. Heathkit employed this technique in one of their shortwave receivers years ago. They used it in the IF to act as a combined selectivity control and BFO. Needless to say, it was not a very satisfactory arrangement.

Variable RF selectivity can be useful even in a receiver with an RF stage. The only caution is to use the high selectivity in the antenna section. If the high-Q tuned circuit is the plate or collector load, the gain of the RF amplifier will increase as the Q increases. The

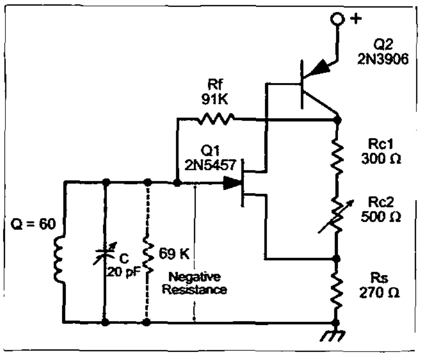


Fig. 3. A negative resistance can increase RF selectivity.

increased gain could exceed the maximum stable gain of the RF amplifier. This caution is appropriate for both transistor- and tube-type amplifiers. When the RF selectivity is used in the antenna section before the signal experiences any amplification, strong off-frequency signals can be suppressed before they can drive a stage into its nonlinear regions and generate crossmodulation or intermodulation products. **Fig. 4** shows the simplified antenna section of a receiver. The "negative resistance" block is the circuit shown in **Fig. 3**.

The negative resistance generator can bring the old single conversion receivers back to service for just a few dollars and a couple of hours with a soldering iron. Yard sales often have old shortwave radios that can yield the basic stuff for turning a sow's ear into a silk purse. If push comes to shove, you could use an old shortwave receiver that otherwise might not be worth reviving because it doesn't have tubes in the sockets (tubes are expensive these days, if you can find them). If it has the RF section reasonably intact, coils, band-switching, and tuning capacitor, it can be used to build an offboard preselector. True, the tracking of the preselector and receiver is a problem, but the improvement in interference rejection can be worthwhile—especially in the 40m band, where the high-powered broadcast signals raise Cain. 73

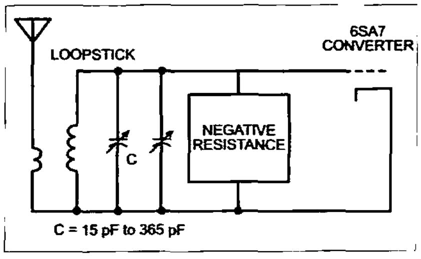


Fig. 4. Partial schematic of the antenna section of a simple receiver.

73 Review

The Agrelo Engineering DFjr Doppler Direction Finder

A fast track into T-hunting!

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92837
[Homingin@aol.com]

Doppler radio direction finding (RDF) installations are easily identified by their array of three to eight vertical whip antennas. A switching circuit connects the whips to your receiver one at a time in rapid sequence to simulate a single whip moving in a circular pattern. Due to a property of physics called the Doppler Effect, this apparent antenna motion applies periodic frequency modulation to incoming signals. The display unit detects the phase of this FM with respect to the antenna switching sequence. This tells the direction of the signal relative to your vehicle heading.

If your RDF need involves the DX bands (below 50MHz), very weak signals or signals with no carrier such as single-sideband voice, forget about using a Doppler. It is also not the best choice if you will be doing your tracking on foot, if you want to do RDF remotely from a mountaintop radio site, or if the target signal is horizontally polarized. But if you want to go mobile to find a strong VHF-FM or UHF-FM hidden transmitter, spurious signal or jamming station, a Doppler may be just the right tool for you.

Because the simulated rotation rate is about 30,000 rpm, Dopplers can capture bearings on signals lasting only a fraction of a second. They attach to ordinary mobile or hand-held FM transceivers and require no rotating parts or holes to be drilled. That means you can join the hunt in minutes, even in a rental car.

Until recently, you had the choice of spending at least $600 for a commercial wired/tested Doppler set or building your Doppler at home for about $150 plus hours of parts gathering and construction. Now there is an attractive third option, the DFjr by Agrelo Engineering. It is not a kit, but a complete plug-and-play RDF add-on for 120 to 550MHz, made in the USA and selling for about $350. Your only assembly tasks are mounting whips and magnets onto the antenna unit frame and installing the system on your vehicle.

Honey, I shrank the Doppler!

The DFjr display box (**Photo A**) measures only 2-3/4 x 4-1/2 x 7/8 inches. It's so small that I misplaced it a couple of times before I got it installed in the van. There are no protruding switches or knobs, so it fits nicely in a shirt pocket. You might think that it could be mounted anywhere in a vehicle, but there are practical limitations. You can't just place it atop the dashboard, because all connectors are on the bottom edge. You need to find a shaded spot that is easy to view by driver and assistants. Provide a solid backing so you can depress the three buttons firmly. For me, the best solution was making a pair of aluminum strip brackets to span between the heater duct and the instrument cluster. Velcro® strips hold the DFjr to the brackets.

Any function operation requires pressing sequences of one or more of the three membrane buttons on the panel. The manufacturer says that these switches require only 100 grams of force, equal to the weight of three parakeets. But in my

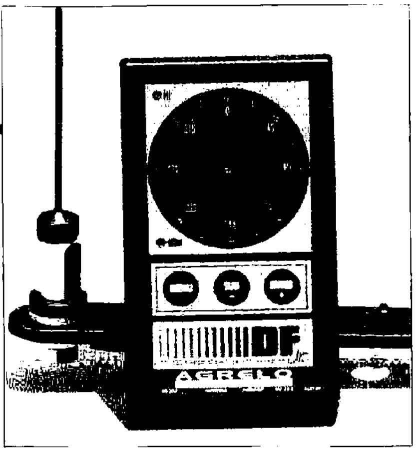


Photo A. The DFjr display box is about the size of a cigarette pack. Here it is next to one whip of the original version antenna set. All photos by author.

tests, the center button required 500 grams and the two edge buttons needed almost a kilogram to actuate. Some users report that they miss the positive tactile feel of ordinary push-buttons. I agree, and I would also prefer a digital readout or auditory feedback to indicate what modes have been selected.

The display box has no room for a speaker. Most users plug the DFjr into the receiver's external speaker jack and plug an external speaker into a jack on the DFjr. The alternative is rewiring your radio's external audio output jack so it doesn't cut off the radio's speaker. Agrelo provides the audio cable from radio to DFjr, but not an external speaker or its cable. Audio plugs and jacks are 1/8-inch connectors, not the more widely used 1/4-inch types. There is no power on/off switch. I got tired of pulling out the 12VDC connector sandwiched between two audio cables, so I bought an in-line switch from a hardware store and installed it in the cable.

The DFjr has a circular directional display of 16 light-emitting diodes (LEDs). There is an LED in the center of

the circle, making it easier to interpret the readings in a dark car at night. Red HI and LOW LEDs help you set the audio level from your receiver. The LED indicating low level must be off for the unit to process bearings. Occasional flashing of the HI level LED is OK, but too much audio will make it come on continuously and performance may suffer. When Doppler tone falls below threshold level, the display automatically holds the last bearing.

As with other Dopplers, you should recalibrate the display each time you change receivers, vehicles, or ham bands. There is no rotary calibration control; you press all three buttons simultaneously when the target signal is known to be dead ahead. A parenthetical note to readers who wonder why not calibrate by having someone stand directly in front of the car with a keyed hand-held: You probably will not get a highly accurate calibration on any VHF Doppler set that way, due to near-field multipath and a non-planar wavefront. It is much better to be driving toward a known-location signal such as a repeater or NOAA weather station. Better yet, have a fellow ham transmit while driving several car lengths ahead of you as you move along with your Doppler setup.

An evolving antenna

To go with its novel display unit, the DFjr includes a complete easy-to-install mobile antenna system. Its aluminum crossarm frame has twelve holes so that whips can be quickly and accurately positioned for the 2m, 125cm and 70cm bands. The switcher consists of four monolithic RF preamplifiers and switching transistors in a weatherproof enclosure at the center of the array (**Photo B**).

The original antenna set, partially shown in **Photo A**, had one large magnet directly under the switcher box. Early users quickly discovered that this design was unacceptable. The lack of a counterpoise for each whip severely degraded RDF performance. When four magnets on "pigtails" were added to RF-couple the coax shields to the car roof at the base of each whip (antenna Version 2), performance improved markedly.

Agrelo's staff redesigned the array to have four fixed magnets, one under each whip (**Photo C**). Many of these Version

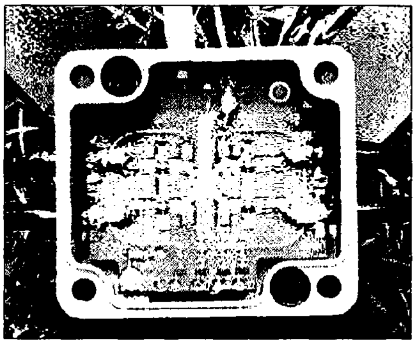


Photo B. *The antenna switch enclosure measures 2-1/2 x 2-1/4 x 1-3/8 inches. A waterproof cover and gasket (removed for the photo) keep rain and dust out.*

3 sets worked well, but some developed shorts at the whip bases. In my case, shrink-sleeve tubing covering the crimp portion of a solder lug cold-flowed to create a low-resistance condition that made the display "wander" randomly. The problem was not detectable with an ohmmeter, but I could observe differences in pulse waveforms on the whips with an oscilloscope. That antenna version has chrome-plated hex upper nuts and black whip-holding caps with hex-head setscrews. If you have one, I recommend that you add tape or other insulation at the crimp ends of the lugs at the whip bases to avoid shorts.

Shorting problems have been solved in the latest antenna set (Version 4) being shipped to new buyers (**Photo D**). It has a plastic coax termination at each whip and conical upper nuts with slot-head setscrews. An instruction sheet with eight color photos shows you how to put it together. The four mag-mounts are high quality with rubber padding to

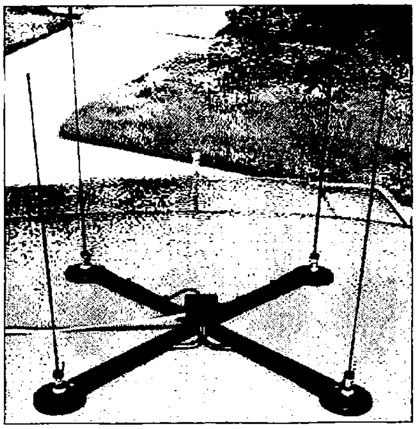


Photo C. *The four-magnet antenna assembly quickly mounts on almost any vehicle. This is the third version.*

protect your vehicle's finish. Unless you have a nonmetallic or deeply corrugated rooftop, installation will be a snap. (Four snaps, actually.)

The Version 4 antenna set has a 12-foot data (RJ-25C) and RF (RG-58) cable, enough for sedans and trucks. I prefer to mount the antenna set at the rear of my minivan's roof; the cables are about three feet too short for that. Extension cables are available from Agrelo Electronics, or you can make your own.

While any Doppler RDF set can be modified for computer interface by adding a serial communications board, the DFjr is computer-ready right out of the box. Its RS-232 serial port feeds relative bearing information at one of five selectable baud rates. You can program it so bearings come out of this port only when their quality is above a desired threshold. With Agrelo's optional multi-port adapter (MPA) accessory, a laptop computer, packet terminal node controller (TNC) and separate VHF-FM transceiver, you can transmit your position and RDF bearings via Automatic Packet Reporting System (APRS). You can also display the bearings of other similarly-equipped T-hunters in the APRS network on your laptop.

The MPA combines RDF and global positioning system (GPS) data onto one computer port. The rate at which your position and RDF bearings are transmitted on packet can be selected from five-second to 16-minute intervals, or entered manually by pushing two buttons on the DFjr. While your setup transmits packets, the DFjr automatically halts RDF processing, avoiding bearing errors due to QRM from your packet transmitter.

How smart is it?

Besides the DFjr's miniaturization and plug-and-play attributes, Agrelo Engineering touts its "smart" processing. The manual states, "Although no unit can eliminate multipath and signal dropout, the DFjr simply ignores the effects." In point of fact, no VHF RDF set, Doppler or not, can ignore multipath.

Let's say you are parked along a road through a canyon and the target station is over a hill to your left. Direct signal is greatly attenuated by knife-edging over a ridge. At the same time, this signal is being reflected toward you from a hilltop in another direction. This condition—signals from the same source arriving via more than one route—is the definition of multipath.

If the reflected signal is stronger than the direct signal, your Doppler will either indicate that the signal is coming from the hilltop (an erroneous bearing) or it will show a "wild" bearing between the two signal sources. If you and your Doppler begin moving under these conditions, the relative strengths and phases of the direct and reflected signal components will change continuously at your antenna, making a traditional Doppler display flicker, jump and "dash around the ring."

By narrowing the bandwidth of the tone filter in a traditional Doppler processor, jumps and flickers are reduced substantially, but there are practical limits to this technique. Doppler users "eyeball average" the dancing display to deduce their best estimate of the true direction of the signal source. That works for experienced T-hunters in most situations, but if there is insufficient direct signal relative to one or more very strong reflections, no amount of "brain processing" will turn bad bearings into good ones.

The DFjr has two operating modes. In the Raw Mode, bearings are displayed in real time with moderate tone filtering, just as in traditional Dopplers. In the Statistical Mode, the DFjr accumulates samples for approximately two seconds, digitally processes them with a proprietary algorithm and then displays the resulting estimated bearing.

The garbage-in/garbage-out principle applies to the Statistical Mode. If your vehicle and the target emitter are stationary, and if there are no moving reflecting objects in the signal path, all sample data points will be alike and there will be no difference between Raw Mode and Statistical Mode indications. If you are moving in a straight line and enough good data can be captured in the sampling period, a good processed bearing will result. But when you are in an area where most or all of the incoming signal is reflected, no amount of statistical analysis will turn two seconds' worth of bad data points into a good bearing. Furthermore, if your vehicle turns sharply or if there is more than one signal received in the sample period, the calculated bearing for that period is meaningless.

I have used the DFjr for several months, taking lots of test bearings on stations in known locations and going on competitive T-hunts hidden by very clever hams. I frequently change from Raw to Statistical mode and back again, just to get a "feel" for the RF environment where I am at the moment. In the Statistical Mode, a new bearing appears about every two seconds, sometimes 180 degrees from the last. It makes me wonder, "Did I pass the hidden T or am I being deceived by multipath?"

With lots of tall buildings, canyon freeways and mountain peaks within our southern California T-hunt boundaries, severe multipath is a way of life. Some T-hunters claim there is no place in the US where it is worse. It takes time to learn to use any Doppler in this environment. If you are like me, you won't win your first strong-signal T-hunt with your DFjr, but you will eventually find the transmitter or at least get as close as you can by road. Your skill will improve as you gain experience, just as it does with any other RDF method.

Is it accurate?

When describing measurements, it is common for the terms "accuracy" and "resolution" to be confused. DFjr's advertising is a case in point. The Agrelo Web site states that the DFjr has ±1.40625-degree accuracy in the Statistical Mode. Don't take this to mean that your bearings will always be within a couple of degrees. That number is not the RDF accuracy, it is the resolution of the digital output from the RS-232 data port.

In the data output, the 360-degree azimuth range is described by 256 bits, each bit representing about 1.4 degrees. But even if you could perfectly calibrate a Doppler and even if there were no such thing as multipath, ±1.4-degree bearing accuracy over the 360-degree range is not a reasonable expectation, due to factors such as mutual coupling among whips in the antenna system. Tests by a maker of Doppler sets for the military have shown that sophisticated 4-whip Dopplers are capable of only about ±5-degree accuracy under ideal conditions, no matter how good their resolution.

Steve Hall KK4PM performed accuracy tests of his DFjr on known-location repeaters last summer and reported his results to the APRS Internet mailing list. His computer program automatically

compared his field bearings from the DFjr data port to GPS-computed headings from his field locations to the repeaters. Sure enough, Steve found that computed accuracy was about ±5 degrees when he was driving in the clear and worse in areas of high signal reflections.

If your DFjr is not connected to a computer, your bearing indicator is the 16-LED Doppler readout, which provides only ±11.25-degree resolution. While not good enough for precision triangulation, it's fine for homing in on a hidden transmitter in a mobile T-hunt. Just let the display lead you down the roads.

Sure would be great if ...

Agrelo Engineering is the first company to bring a microprocessor-enhanced Doppler set to the amateur radio market. Digital Doppler technology has plenty of room for innovation and there are many features that could be added. Since there is already a microprocessor in the unit, I wish it had a "smarter" user interface. How about including memory to store multiple calibration factors for various bands and receivers?

It would be useful to have the ability to select the sample period time over a 0.25- to five-second range, to adapt to a variety of multipath conditions and transmission lengths. Maybe the LED in the center of the display could be made to flash at a rate corresponding to the amount of multipath, as evidenced by variation in data points during the sample period. Rapid flashing would indicate high multipath, whereas consistent data would result in a steady glow.

The DFjr is not sold in ham stores. It is available only from Agrelo Engineering, P.O. Box 231, Pattersonville NY 12137; phone (518) 864-7551. A new detailed operator's manual has just been issued to replace the rather sketchy one originally supplied. For more information, contact the company or visit its Web site. Since that site is presently in the process of changing servers, I suggest you use the link from the Homing In site [http://members.aol.com/homingin/].

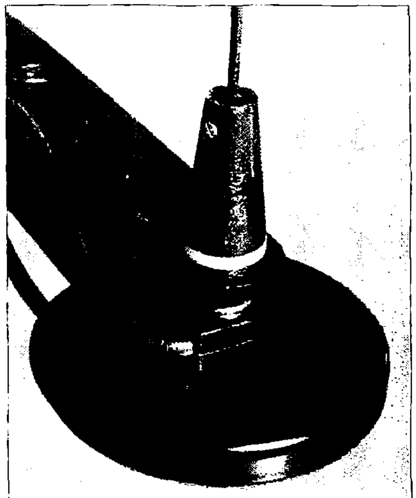


Photo D. *The latest antenna set (fourth version) has a molded coax termination block to prevent shorts at the whip bases.*

Number 28 on your Feedback card

73 Review

Sony's ICF-SW100S

A micro-sized shortwave communications receiver with full-sized features.

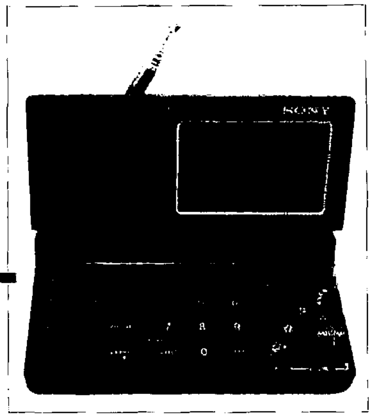


Photo A. Close-up front view of the ICF-SW100S.

David Pelaez AH2AR/5
7309 Centenary Drive
Rowlett TX 75088

What weighs seven ounces, is only a little bigger than a pack of playing cards, and can take you to distant lands without the need for you to leave your easy chair? No, it isn't a portable transporter beam. It's the ICF-SW100S pocket shortwave receiver, available at your local consumer electronics or amateur radio store for only $349!

Finding a pocket-sized, high-quality, dual-conversion communications receiver may at first sound like science fiction, especially one that contains a digital readout, memory "channel" capabilities, and the ability to demodulate upper and lower sideband shortwave radio signals. The receiver also incorporates a circuit capable of AM synchronous detection—more about that later.

Let's take a closer look at this minuscule receiver. Measuring 4-3/8 inches by 15/16 inch by 2-7/8 inches, this receiver is about as small as they come. It's powered by two AA batteries; you can expect to get about 24 hours continuous use from alkalines, and about 60 hours use from lithium batteries.

Also supplied with the receiver is a hefty (overkill, here) AC power adapter, a pair of headphones, and as an added bonus a preamplified active antenna module with a convenient built-in transmission line reel, which allows for the option of collapsing the built-in receiver antenna and placing the active antenna module on a windowsill.

The on-board amplifier exhibits about 10dB gain (measured at 10MHz) and climbs to nearly 15dB at 25MHz. Also, a switch is used on the module to broaden or narrow the amplifier bandwidth for four selectable band segments. Weak, barely audible CW signals on the amateur bands were quite copyable when the active antenna was utilized. Surprisingly, it is unnecessary in most cases to employ the preamplified antenna module, as the sensitivity of this tiny receiver is impressive. Measured sensitivity for this receiver is 0.25 microvolts for 10dB S + N/N (measured on 10MHz).

"The synchronous detection in this receiver works superbly on fluttering/fading shortwave AM broadcast bands."

Another bonus is selectivity. Listening to the crowded 80m and 20m amateur bands on a Thanksgiving morning was a good test for the receiver's ability to separate crowded amateur radio signals. This is where this little receiver excelled. The sensitivity and selectivity also really help when DXing AM broadcast radio signals. In spite of the receiver's obviously small built-in loopstick antenna, it has proven to be an equally good broadcast-band DX receiver.

How does it sound? The tiny 1-5/8-inch, eight-ohm speaker has plenty of volume and a very crisp communications-quality sound that favors the high end. The absence of bass makes music sound a little tinny; however, the sound quality while listening to FM stereo broadcast signals using a set of good headphones is unusually good. A tone switch on the side of the receiver alters the audio frequency response and optimizes the built-in speaker for "voice" or music.

Tuning

The tuning range is 150kHz to 30MHz and includes 76 to 108MHz FM. Audio stability while listening to SSB amateur radio signals and CW signals is excellent. Moving the receiver around or bumping it causes only a slight change in tone while listening to SSB or CW signals. The "bump" test on some other receivers sometimes causes unacceptable change in frequency. The slight change noted on this receiver is not objectionable nor does it interfere with intelligibility.

Because the receiver is really too small to utilize a vernier knob, tuning is accomplished by four buttons that allow for "coarse" and "fine" tuning up and down frequency or direct keypad entry. While in upper or lower sideband, the "coarse" tuning buttons allow the listener to step through the frequency at 1kHz increments. By keeping the button down (in upper or lower sideband mode), a scan function takes over, moving at a rate of about 100kHz in 15 seconds. The fine-tuning buttons move the

received frequency at 100Hz steps while in sideband mode for each press of the button. The "coarse" tuning automatically changes step rates while in the "AM" mode. It will step at a rate of 100kHz in three seconds, or 5kHz increments for every single push of the button.

Explaining the tuning rates in writing makes it far more complicated than it really is, as it only takes a few minutes to get used to the button tuning rates. Direct keyboard entry is the way to get to a particular frequency quickly, and a total of 50 available memory channels will store your favorite frequencies for quick access. In the AM mode, the easy-to-read liquid crystal display resolves the received frequency down to 1kHz. Although "tenths of a kHz" (100Hz) is not displayed, in SSB it takes ten clicks of the fine-tuning button to move up or down frequency a single kHz. By keeping track of the number of times you have pressed the fine-tuning button, you can resolve the received frequency down to 100Hz, e.g., 14,103.1kHz.

In addition to frequency storage, a label edit function is convenient to label the stored frequencies' contents—such as "WWV" on 10.000MHz, shortwave broadcast call letters, or country designations. Optically, the LCD readout exhibits excellent off-axis performance. Alphanumerics stay sharp and distinct on the screen when it's viewed from any angle.

Synchronous detection

A beautiful feature Sony has designed into this receiver is the capability to store the mode (upper or lower sideband, AM, or FM broadcast), including the ability to recall whether synchronous detection is desired while in the AM mode. This is the smallest shortwave receiver made that employs this circuit.

What is synchronous detection? There are two big problems listeners have when DXing AM medium- and shortwave broadcast stations. When a carrier component drops out of a portion of the received signal, fading occurs, and it is usually most dramatic on the shortwave frequencies, due to propagation changes.

The synchronous detection injects a pure carrier frequency with the signal's original carrier. This artificial carrier is mixed with the received signal to compensate for the lost or greatly attenuated carrier component. Does this system work? I was naturally skeptical of this analog signal processing technique, and was really surprised to discover that the synchronous detection in this receiver works superbly on fluttering/fading shortwave AM broadcast bands. The synchronous detection circuit can also be energized on the AM mediumwave broadcast bands, a real "plus" for AM DXers.

"Weak, barely audible CW signals on the amateur bands were quite copyable when the active antenna was utilized."

Another common problem shortwave listeners encounter involves closely stacked broadcast stations using a double sideband transmission. They usually will interfere with each other as one of the sidebands is affected from the adjacent signal, causing a "beat" or heterodyne. Synchronous detection also helps in this situation, as the other unaffected sideband can be selectively received, and will null out the sideband that is being interfered with by the adjacent signal.

Other functions include the capability to receive FM stereo broadcast stations, a world clock, and the ability to use the clock as a wake-up timer, an important traveling necessity. The ICF-SW100S has proven to be an extremely versatile receiver, and is certainly one of the smallest available. Don't let size fool you, because the "large radio" features on this flea-sized receiver make carry-along shortwave radio listening a lot of fun.

Also, the clamshell design is very practical. This configuration allows the user to listen while the receiver display is closed. I have found this receiver excellent for listening to amateur radio QSOs while away from the shack. With this rig in its shut configuration and the antenna swiveled to the side, "shirt-pocket" monitoring is a reality. Try doing *that* with your TS-950S!

Emergency Communications

The only salvation for ham radio?

Dave Gerbig WB9MZL
3504 South Tremont Way
Bloomington IN 47401

Have you seen the current price paid for frequencies? The FCC, our friendly federal supervisory agency, has discovered the value of the radio frequency spectrum. The past few years have seen several frequency auctions. The government is garnering billions of dollars for frequency bands no larger than some of our ham bands. Every company with geographical dispersion and either service or delivery people roaming the countryside wants to know exactly where those people are. They also want to tell those people where they should be or should go next. The best way to accomplish this is radio. When you add in automatic location reporting, the company managers think they're close to heaven.

Almost everyone wants a portable/mobile telephone. Some want more than one. Some occupations nearly force people to own a portable phone. Does anyone remember the good old days when a beeper was regarded as either a status symbol or major annoyance? Now, look at the billions in profits the better-run cell-phone companies are reporting. No wonder the bureaucrats in the FCC feel they're missing something.

Two years ago a group of companies bid for, and received, a band of frequencies near 2GHz. This band was roughly the size of the 70cm band. The accepted bid was over 2.5 billion dollars.

We have perhaps a half million active hams in the US. How many would we have if the entry fee for use of just one band was $5,000? Perhaps we could work out some way to *rent* a frequency on days we wanted to use it. That certainly would kill some activities, such as calling CQ, nets where people check in with no traffic, etc. Would you rent use of one (160-10m) frequency on the off chance someone might answer your CQ? You can try to figure the chances that person who has bought the corresponding share of "your" frequency might have something interesting to say. A better use of your money might be investing in lottery tickets. Would you pay an annual fee for use of your favorite 2m repeater? OK, when did you last pay your repeater association dues? If we had to pay for use of our ham bands, there would be no ham radio.

There may be just one area where we can justify our continued unrestricted usage of the valuable limited natural resource, the radio frequency spectrum. Remember from your Novice exam questions there was something about ham radio providing a pool of trained operators, promoting international goodwill, technical innovations, and emergency communications? Can one of these official benefits of ham radio actually *save* ham radio?

US vs. them

First, the pool of trained operators was a blatant effort by the military to sidestep training CW operators in case of war. They no longer use CW. The typical military radio has become foolproof. The only thing that keeps hams above average in understanding technology is that each year, our public schools present us with new and improved fools. There are few things for the operator to adjust other than the received volume. Mostly, what we can expect from the military is that they like us to keep some frequencies (we think of them as ours) available for military use during emergencies. The government can issue one statement and we are gone. The military then moves into the recently vacated (our) frequencies.

Is the promotion of international goodwill the salvation of ham radio? Look at the list of countries allowing ham radio. Most are countries where the people like the ideas the US promotes. Does ham radio enter into shaping their public opinion? The countries that do not like US views on things do not have many hams. We are not going to influence public opinion nor foster feelings of international goodwill in such countries. The countries that oppose US views do not allow conversations on certain political subjects. Again, we cannot affect international goodwill in such situations. The authorities in such countries do not care what the people think. The Cold War ended several years ago, so our own government sees little need to cultivate goodwill among other nations. The government view is that the Cold War ended because of the efforts of the government. The opinions of the people were never a factor, in the authorities' view.

Technical innovations? Get real!

How much brainpower does it take to take a hand-held out of the foam packing? When was the last time you built something? Did you actually think it was as good, if not better than, something you could buy? When was the last time you thought of something you wanted to use your radio to do, and couldn't do, because of the equipment's limitations?

Ham operators have developed several great technical innovations: the use of high frequencies, such as everything higher than the AM broadcast band; single sideband; and others. What technology has ham radio developed during the past ten years? During the past 20, 30 or 50 years the answers would be the same. Spread spectrum transmission, one of the current technological innovation darlings, was invented and patented 55 years ago. This "new" technology was invented by a movie star, using piano player rolls. Crude, but it worked. Now the technology has caught up and spread spectrum is the coming technique. Does anyone want to bet there is at least one ham in your club who cannot set the clock on his VCR? We are expected to be the technical innovators of the future!

(If you don't remember, the star was Hedy Lamarr; she was granted the patent for a Secret Communications System on August 11, 1942. The original plan was to guide torpedoes via radio control. The frequency changing was to prevent enemy jamming of the signals. It did work, but the US Navy thought Hedy could do more for the war effort by selling bonds.

This torpedo guidance could have been a major development—if it had been implemented. During the first half of World War II the German and British torpedoes were much more accurate than ours and the Japanese had torpedoes with both greater range and better accuracy than the American Navy's.)

That leaves emergency communications on our list of justifications for ham radio. With the exceptions of tornadoes, floods, or hurricanes, weather is almost never a cause of telephone problems. When you consider the redundancy provided by ten or more long-distance network companies and the cell-phone companies, when are we hams needed for communications?

Sit down, Elmer, and take one of your pills

I didn't say hams wouldn't be needed. I asked *when* will we be needed? The need for true emergency communications over long distances will hold for isolated areas such as islands and Third World areas. While inside the US, our long distance capabilities are useful in two types of major emergency situations: initial reports, and health and welfare messages. For smaller-scale emergencies in the US we can expect years of opportunities, if, and only if, we can show our capabilities and get the recognition we need from the proper (local and state) officials. Floods, tornadoes, and hurricanes are capable of destroying communications towers and buildings—and recently the US has joined the rest of the world in experiencing terrorist bombings. Floods will cover houses, cables and equipment housings. Hams must be ready for smaller localized emergencies.

The development of fiber optics means there is more telephone company equipment scattered over the countryside. Very few people have fiber optic service direct to the house—the conversion from fiber to copper circuits takes place in manholes, huts, and cabinets here and there, usually near residential neighborhoods. What effect on normal communications the combined effects of the incorporation of fiber optics and a flood or major storm will have is anyone's guess. The equipment performing the change from fiber to copper circuits will work while the equipment has power and is dry. It will continue after loss of commercial power while the battery holds, or if the repair people can get a standby generator to the site.

During a flood or storm, often the area power lines are shut down because of the risk to rescue workers. There are limits (read "costs") as to how much reserve battery the communications companies can afford to put into each remote terminal site.

Cell-phone-type technology will be less affected, as the tendency is to put cells on hilltops for better propagation. Floods don't get them, but power loss can. One cell company is building sites on a grid pattern eight to 10 miles apart, across the country. There are not enough portable generators in the world to cover them if they lost power! This can become one situation where older is better. During a major wide-area power outage, older all-copper circuits from a telephone office should continue to function. The newer circuits such as fiber and cell technology types will only work where the remote sites have backup power sources. Telephone offices usually have batteries sufficient to last hours, then standby generators sufficient to run all the equipment, lights and air conditioning.

If we hams are to be respected as emergency communication providers, we need to prepare for the actual-type emergencies we will face. While Field Day is great fun, are we going to need long distance communications from some city park during our most likely emergency event in our community? Field Day is a tradition, and the experience received in setting up temporary stations and the activity will serve well when we need emergency communications on whatever band. I have a question for all Field Day participants—are you learning anything, or are you simply repeating the same mistakes each year?

I know of a club that spends up to six months preparing for Field Day. The site is selected. The area is mapped and scale drawings prepared. Antennas and supports (using existing trees wherever possible) are selected. Additional supports are pre-built for locations where no tree exists. After all this planning one helpful old-timer arrives early and puts all the antennas up the same as they were the last time this location was used. This old-timer never operates Field Day; he is the hospitality committee. He never remembers the reason they did so poorly last time. The big reason for the poor results last time was mutual interference between the various stations. (The planning committee suspects that the old-timer's requiring all antennas to use a common center support is a factor.) This is excusable one time, not *every* time for 25 years.

What new technology should your emergency preparedness group look into before the next emergency? Until you have worked with positioning via GPS location and packet reporting, you cannot appreciate how great an idea this combination can be. I recommend the article "Automatic Position Reporting System" published in the December

1996 edition of *73 Magazine* for more information about this system. Then be creative and find ways to use this equipment during your next emergency drill or real situation.

What happened to the sign?

How well do you know your county or city? Imagine attempting to tell someone your location when every street sign and landmark building has gone with the wind of that hurricane or tornado. I know that in my county, the firefighters and police dispatchers relay directions to the emergency responding units. There are many new and changed streets—the only people really up on the latest streets and developments are the utility engineers and construction workers. They learn the areas before the street signs are installed. Any street sign listing something the local Neanderthals find interesting (or offensive) will result in that sign being AWOL just when it is needed for emergency response.

I just finished an emergency exercise where the problem preparation team drove the target area three days before the exercise, using a map. During the exercise, the initial survey and assessment teams (using street signs for reference) reported their location as being the intersection of two parallel streets; if the preparation group had *also* looked at the signs, they'd have noticed that the street signs were incorrect! Why no one else noticed (or complained) is a mystery.

Picture it: Your emergency assessment team starts out towards a suspected disaster area. They soon need to report injuries or damage and request assistance. They need not take time to find a street sign or landmark—headquarters already has their location and the locations of all other teams displayed on the computer screens at the emergency coordinator's office. The support team with the required skills and least travel distance can be dispatched. If all emergency response teams have this APRS capability, only the coordinates need be sent. The GPS equipment can direct even a newcomer to the correct spot. If you want to win over a hesitant emergency coordinator or other official just demonstrate this real-time location reporting capability. It works!

How much practice do you need?

If you or your organization are to provide effective support during emergencies, then there must be several qualified net control operators and *everyone* must be familiar with net procedures. Simulated emergencies are not the best answer. There just is not the adrenaline needed and you get too few volunteers. Get the practice you need with as many real situations as possible.

These need not be emergencies—just look at the activities in your community. There are parades, running events, bicycling events; anything that brings people together is an opportunity. Look for events where there is some physical activity; a little activity in today's couch-potato society will guarantee at least an occasional call for medical transport. I suggest distance running and bicycling events for practice. The geographical spread makes the need for communications real. The exertion and need for water, food and medical support can give you real problems for your net. Also, you can have perhaps a year to prepare for these events.

Look for events outside the boundaries of your immediate neighborhood, too. During an emergency you will need familiarity with adjoining counties and perhaps even adjoining states. You will certainly need to know the communications problems within your area. If all your practice is from hilltops with a clear view of the horizon and the handheld range is 75 miles, what will you do when a real emergency occurs at the bottom of some canyon where the radio horizon is less than two miles away? To develop the knowledge and skills needed to overcome such problems, you should work as many different events as possible.

Learn to use ham TV; there is no better way to impress people than with live pictures, shown at the emergency response headquarters, and with your ability to tell the camera operator to zoom in on the object just left of center screen. If there isn't an ATV group in your area, start one. The same goes for portable packet and satellite communications groups. During an emergency you may need communications beyond 2m simplex range, but not the worldwide capabilities of the low bands. Get a GPS receiver with the capabilities to interface with your portable packet station. Package the equipment in a compact bundle so you can transfer to another vehicle when needed. This could be a good use for an under-utilized computer.

When you set up a portable station at an emergency site, does your group demonstrate professionalism and efficiency? Why not package a convenient length of coax, an omnidirectional antenna and a support structure in one package. I suggest a J-pole antenna. They are easy to construct and compact. My favorite support structure is a Fiberglas™ telescoping pole made for electrical and telephone industries to measure the height of high-voltage lines. They consist of several concentric tubes about five feet long. To use, you pull the smallest tube out until a snap-locking pin locks to the next larger tube. You repeat this process until you either have sufficient height or run out of tubes. Commercial suppliers provide similar steel poles for ham and TV antennas. These supports need added stability from guy wires. You need to include guy material, and don't forget the appropriate anchor devices, in your prepackaged emergency kit. An alternative support is a base plate with a vertical post. You place the mast over the post and park a car or truck wheel on the base plate. After you park the vehicle, keep the keys. Otherwise, you may abruptly (and involuntarily) leave the net.

Communicate effectively

To forward a message to another site, check first to see that it is understandable. If the message will go through several relay people ask yourself, is it concise? During an emergency you may be routing messages through people who have never handled a message, even in a non-emergency situation. Humor the newcomer, and keep the messages short and understandable.

If you are given a message that doesn't make sense, ask the people originating the message to rewrite it. A few minutes taken to rewrite the message, preventing a series of calls for clarification, is much more efficient than any alternative.

Practice, practice, practice

You need to develop your skills before the emergency occurs. The best practice

is to have real situations, then figure how to overcome the problems that occur. The type of practice depends on what is available in your area. Here in the Midwest we can practice net operations with tornado spotting nets. We also have cave rescue and lost person operations. Then there are the usual parades, large gatherings of people at civic events, and amateur sporting (running, walking and bicycling) events. If you feel these events lack the challenge of a true emergency, a few years ago someone forgot to secure access to a drinking water source for a fireworks display that attracted 35,000 people. The panic when they ran out of popcorn the year before had been bad enough. These were evening events in town. If the problems had occurred twenty miles from town in dreadful weather, the problem could have become a crisis.

Each event should be viewed as an opportunity for you and your ham group to learn more about your communication capabilities and deficiencies. You want to learn both the good and the bad. Then use the good to promote your abilities to other groups. Learn from the deficiencies to prevent disorganization the next time you set out to provide communications support.

Each event, be it a real emergency or a practice session, should be followed by an after-action review, with the participation of the event officials; they know what they need to run the event. Ask them how your portion could have been done better. Please encourage hams and other event volunteers to participate in this activity. A good critique of the recently-completed event support is not to criticize anyone; its purpose is to prepare for a better job next time.

Sample information sheet for post-event critique

Date:
Location:
Time:

- Number of medical emergencies: Problems?
- Number of lost people retrieved: Problems?
- Other priority activity:
- Communication problems discovered:
- Suggested solutions for communications problems:
- Other operational problems observed:
- Ham operator skills needing improvement:
- Could we/should we use these items next time or next year:

Ham TV of area activity relayed to HQ?

An eye-in-the-sky—ham TV from an airplane or balloon?

Digital (GPS) reporting of vehicle locations?

Computer-to-computer data transfer via ham radio (packet)?

Alternate modes or frequency bands such as 222MHz for more confidentiality in communications?

Portable repeaters?

Dual-band mobile radios as portable repeaters?

- Any other items that could be of benefit next time:

What is your part? Have you signed up with your local emergency coordinator? Was this recent enough that your data is both on file and current? Have you participated in a drill or communications support activity for a large event during the past three months so you could consider your radio communications skills current? I know you can talk—can you communicate? When was the last time your group investigated your area's needs for emergency communications? How quickly could your group have a dozen portable packet stations set up and operating at remote sites? Would anyone in your group know where to place digipeaters to relay information to the outside world? What leads you to believe that your existing repeaters and digital repeaters will survive the events that take out the commercial communications systems?

Do you have the ability to store packet data directly into a central database? Any time people are sent to shelters, there are many inquiries as to who is in and who is not in the shelters. Then when there is more than one shelter, or some people visit a hospital, there is the problem of uniting families and friends. If someone could format a packet message to record where victims are, we could reduce the time spent looking for people. All this would take is an identifier to tell the computer to record the following fields. Then the message originators could simply enter data in the prescribed format and presto! The computer could locate people quickly. Even if you never need to locate people in shelters, this can beat looking through 40 pages of log sheets looking for a message from someone who needs the truckload of supplies that is now blocking your route home.

Can't your group field several portable packet stations? Join the twentieth century. Take a small cabinet, install a small 2m rig, a TNC, a power supply and backup battery. Then, when an emergency occurs, plug in a portable computer and attach an antenna. (You do know how to operate your packet station using just the garden variety communications software you might find on any computer, don't you?) You now have an instant packet station. There is another approach. Take an under-utilized 386 computer, and build the TNC and radio into the case. You may learn more about RF noise suppression than you ever wanted to know, but you can have an impressive portable packet station. If you can add a four- or eight-line (or larger) liquid crystal display and a keyboard, you have a true one-piece packet station. Innovative use of technology and readiness to serve can keep the future bright for ham radio. 73

At Sea About Marine Mobile Operation?

Weekend boater or dedicated sailor, you need your radio!

Peter L. Barker XF1/KB6ASH
La Jolla de Los Cabos AB-506
San Jose del Cabo, B.C.S. 23400
Mexico

Since the days of Guglielmo Marconi, the value of being able to communicate from vessels at sea has been a major influence on the development of two-way radio technology. Probably the only Morse code that the non-radio communicator knows is the "dit dit dit dah dah dah dit dit dit" of the marine emergency "SOS" signal.

Today, many military and commercial vessels use sophisticated satellite two-way systems with auto-aiming, gyro-stabilized antennas that cost a small fortune; however, the mainstays of marine communication are still VHF and HF radio circuits.

Belt and suspenders

For many recreational boaters, the installation of ham radio equipment has become an additional safety feature for their boats as well as a way of combining two of their hobbies. A word of caution, however: Many modern radios, both VHF and HF, can be easily modified to transmit on marine frequencies. To use a modified radio in this mode is illegal and can result in serious penalties. In a life-threatening emergency, however, the radio may be used without problems.

In such a case, it is also permissible for a non-licensed individual to use the radio on any frequency where help may be found, including marine, military, and ham. Even if you have a regular marine radio on board, it is still worthwhile to have a modified radio installed as a backup. Anytime on the ocean or even lake that you can use a "belt and suspenders" policy, it is smart to do so.

VHF issues

The ham general coverage receiver is also perfect for picking up weather charts and satellite pictures in conjunction with a very simple interface and inexpensive software available from many sources on bulletin boards, Web sites, and commercial vendors.

Let's take a look at some of the practical issues of installing and using ham radio gear on your boat. We'll deal with the easiest first—VHF. The marine VHF band is a group of internationally agreed-upon frequencies between 156 and 162MHz. As you can see, that is pretty close to the ham 2m allocation, and unless you are a purist, it is really not worth the trouble of installing a separate 2m antenna on your boat. The usual half-wave or vertical collinear gain antenna used on recreational and many commercial vessels will function very well on 2m. The ham frequencies are only 8% off the resonance of the marine antenna: you will not have a perfect SWR, but your radio will easily handle the small mismatch. If you are operating on a sailboat, you will be amazed at the over-water range that comes from having the antenna mounted at the top of the mast. It really highlights how close to a dummy load the "rubber ducky" HT antenna is!

Although the marine radios use channel numbers and not frequencies in their displays—by law, they had to be made "sailorproof"—their instruction book usually has a conversion table of channel to frequency. If your radio will transmit on the marine band, you should program in channel 16 at 156.800MHz. This is channel 16, the international emergency frequency monitored by coast guards worldwide, all military and commercial vessels, and most conscientious pleasure boaters. USE IT ONLY FOR LIFE-THREATENING EMERGENCIES.

A word of caution about trying these marine antennas on frequencies other than 2m. Most of these antennas present a DC ground. This is not a problem at or close to the design frequency; but at 220MHz or 440MHz, the antenna is so far off resonance that it will be a short across your radio output with probably expensive and smoky consequences!

Incidentally, most marine antennas are designed for a maximum power of 35W; marine radios are limited by the FCC to 25W output.

HF challenges

Running HF from a boat presents different challenges, as most pleasure boats do not have an HF antenna as standard equipment. There are on the market dozens of mobile antennas sold for use on land vehicles that will perform even better in the marine environment. Some manufacturers (e.g., Spider) offer stainless steel versions for use in a saltwater environment.

The key to operating any mobile antenna and having a good signal is a very

low-resistance RF ground. The boat offers the opportunity to provide a superb ground against which the antenna can work if you know how to take advantage of it.

We are talking about an RF ground here. The negative battery lead of the radio will not provide this, nor will a 10- or 15-foot run of 12-gauge wire connected to the engine block. At HF frequencies, wire over a few feet long represents a significant impedance, and on the higher HF bands it may just as well not be there!

Copper foil

Some brands of mobile antenna claim that they will work using the stainless steel handrail of the boat as a "counterpoise." They may "work," but there is no substitute for a solid RF ground, and the way to achieve this is with copper foil. A continuous run of 3"- or 4"-wide, 5-mil or better foil should be run from the base of the antenna to the engine ground on a power boat or to the keel bolts on a sailboat.

If the boat's anti-electrolysis bonding measures are correct, the engine block should be connected to all metal through hull fittings and with a rubbing brush to the propeller shaft. A second length of foil should be run from the operating position to the same point and connected to the radios' grounding lug. The foil should be laid flat to the hull and can be secured with contact cement. Corners can be turned by folding the foil rather like a mitered corner. Try to run a continuous length. After installation, it can be painted if required.

Connections

The base mounting of the antenna should be connected to the radio using a good-quality 50-ohm coax, and all connectors should be sealed on the outside with silicone sealant or proprietary coaxial sealing tape. It is not a good idea to use foam-cored coax in marine installations, as it is far more prone to "wicking" moisture than solid-core is. For all but the shortest runs, RG-8 or better should be used.

The above installation uses the common land mobile antenna that is brought to resonance by the use of loading coils for the band needed. This is the most convenient way on most powerboats and some sailboats.

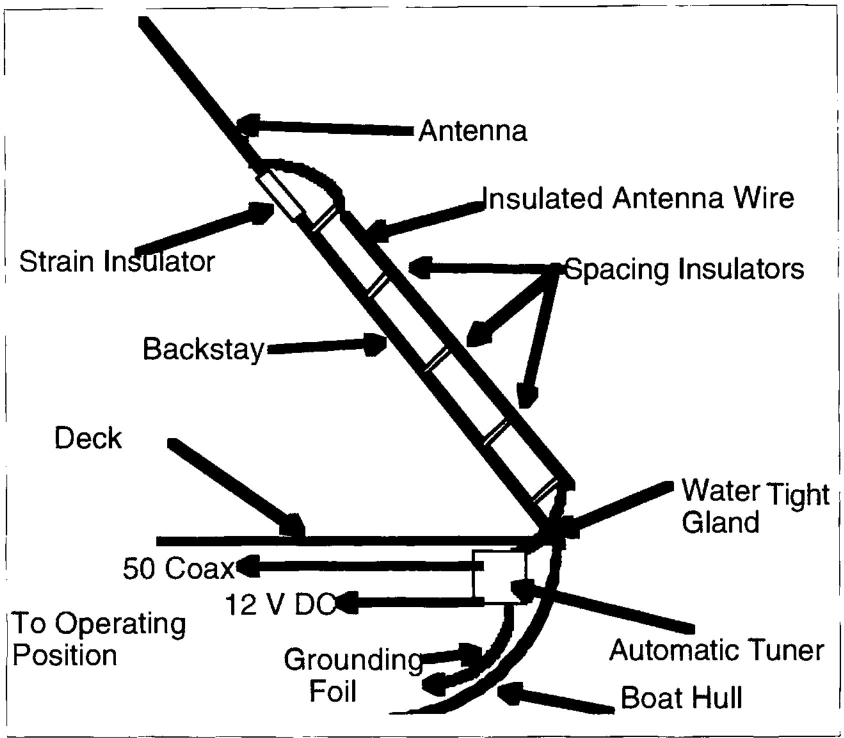


Fig. 1. Tuner at base of antenna.

Using the rigging

An option that has proven very popular and effective on sailboats is to make use of a piece of the boat's existing rigging. Although the stainless steel rigging wire does not have the conductivity of copper, the diameter and length of the stays make them very usable radiators. The most practical stay to use is the one that runs from the head of the mast to the stern of the vessel and is called, logically enough, the backstay. Even on a moderately-sized family sailboat, this stay is over 30 feet long. To use the stay as an antenna, a modification has to be made to its construction, as it must be insulated from the masthead and the rest of the rigging.

The most elegant way to do this is to install special in-line rigging insulators in the stay, the uppermost of which should be three to four feet from the mast attachment point. The lower one should be sufficiently above the deck to ensure that the antenna portion of the stay cannot be grabbed accidentally when it may be in use!

These fittings are the preferred way of sectioning the stay, as they are designed to withstand greater strain than the wire that they insulate. Unfortunately, they are expensive and usually require professional installation. A less elegant (and less expensive) solution is to insert, in the same locations, ceramic egg strain insulators, as used by the power company on poles and guys. If you take the second approach, be quite sure that they will handle the mechanical loads imposed on the stay.

The exact length between the insulators is not critical, since the antenna will need a tuner and be operated as an almost vertical random wire. As a rule of thumb, the longer the better that avoids multiples of one-half wavelength on any of the frequencies that you intend to operate on. The advantage of the random wire approach is that with a tuner it can be made to operate on all ham and marine frequencies.

Tuners

The way this type of antenna is connected to the tuner depends on the type of tuner you plan to use. If your purse runs to it, there are now on the market several tuners (often called "couplers" in the marine electronics industry, made by SGS, Icom, Hull, etc.) designed for matching the 50-ohm transmitter output to a random length of wire. These should not be confused with the automatic tuners built into many modern rigs. The built-in tuners are really designed to "touch up" the match of a near-resonance antenna that is being used slightly off its resonant frequency. They do not have the required range to be used in this application. The suitable automatic tuners are contained in a semi-waterproof housing that will allow them to be mounted in a fairly sheltered location right at the base of the antenna. They are connected to the radio by standard coax

FREQUENCY (MHz)	TIME (UTC)	NET NAME	AREA COVERED
21.402	2200	Pacific Maritime	East & South Pacific
21.350	1630	Pitcairn	Central & South Pacific
14.106	0300	Travelers	Australia & Indian Ocean
14.283	1100	Caribus	East Coast & Caribbean
14.300	1600-2200	MM Service	World Wide
14.313	24 hours/day		
14.340	1830	Manana	Mexico & Pacific
7230	1100	Caribbean	Caribbean
7238.5	1600	Baja	West Coast & Mexico
7294	1445	Chubasco	West Coast & Mexico

Table 1. Some maritime mobile SSB net frequencies. There are many other MM nets around the world that come and go depending upon season and propagation. Some nets change time by one hour when Daylight Savings Time is in force.

and usually a 12VDC cable. This type of installation is shown in **Fig. 1.**

The wire running from the tuner to the antenna side of the insulator should be at least 8-gauge, with high-voltage insulation suitable for exterior use. The wire used to supply the high voltage to neon advertising signs is often used. If the cable passes through the deck, a correctly-sized waterproof gland should be used. These are a standard marine electrical item. If you are on a tight budget, slip a couple of pieces of shrink tubing over the wire where it will pass through the deck, shrink them, and seal the area liberally with marine silicone caulking compound. In this installation, the copper grounding foils should be attached to the lug on the tuner.

A much less costly, but less convenient and efficient, method uses an off-the-shelf or home-brew tuner at the operating position, connected to the antenna feedpoint with a good grade of RG-8 or better coax. In this configuration, there will be, at times, quite a high standing wave ratio on the coax; but at the usually short runs involved, the losses will not be significant, nor at the normal 100W power range in use will heating be a problem. Because of installation difficulties, ladderline cannot be used in this application. This installation is shown in **Fig. 2**.

The feedpoint

The attachment of both the single wire feed and the coax to the antenna feedpoint needs some careful consideration, because it must be a very good electrical and mechanical connection as well as prevent water ingress into the cable. Electrolytic action of dissimilar metals must also be minimized. There are no doubt special mil spec fittings available for this, but the vast majority of installations make use of either bronze split bolt and nut combinations available from electrical supply houses, or small all-stainless-steel hose clamps. Be sure to check the bolt on the supposedly "all-stainless" clamps sold in discount hardware stores, as these are often *not* stainless.

To attach the wire to the stay, use two, or preferably three, clamps or nuts spaced a couple of inches apart on each leg of the stripped coax, or just three on the single wire. The clamps and joint area should be carefully and liberally coated with marine-grade silicone sealant, taking care not to leave any pinholes or gaps where water could be trapped and cause a "noisy" joint. The end of the insulation of the wire must also be carefully sealed, especially the coax, as water "wicking" along the braid will render it useless. In the case of the coax, the insulated section below the feedpoint can be fastened to the lower part of the backstay with cable ties about a foot apart. If available, ultraviolet-resistant ties, usually black in color, should be used.

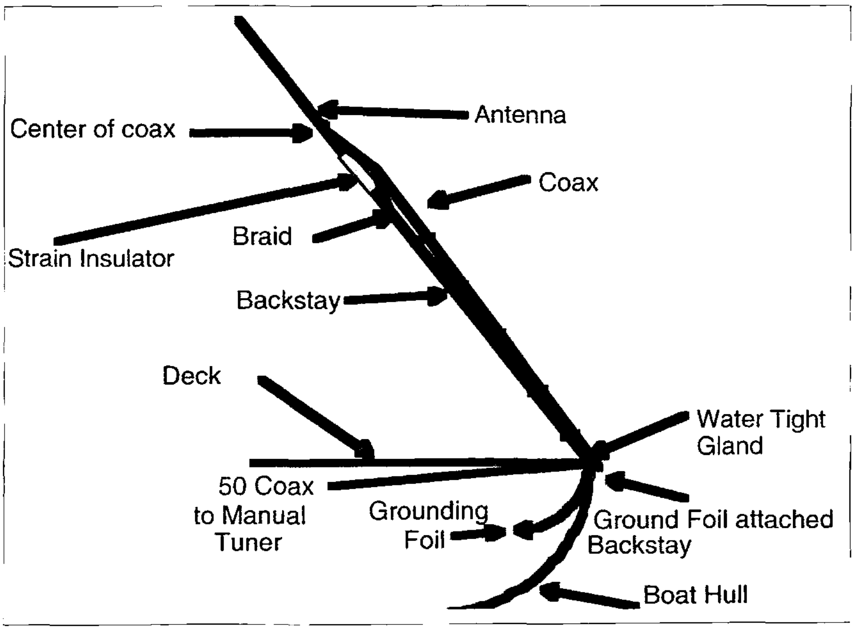


Fig. 2. Tuner at operating position.

The single-wire feed should not be taped along the backstay, as the wire forms part of the radiating system. It should be supported two to three inches away from the stay by insulating spacers that can be easily fabricated from Lucite™ rod or half-inch PVC water piping. The spacer should be attached about every 12 inches along the stay.

The "random wire" principle can also be used on powerboats where a marine-grade Fiberglas™ whip can be matched with the tuner and the same grounding requirements used. These whips are in the range of 23 to 35 feet long, require sturdy mounting flanges, and can put a significant dent in your pocketbook.

Backstay antenna here to stay

The backstay antenna is standard on almost all long-distance cruising sailboats; and given good grounding, thanks to the excellent conductivity of the saltwater, it has enabled boats with standard 100W transceivers to maintain contact with hams ashore from the farthest reaches of the oceans.

There are, in fact, regular nets in many countries around the world that listen for just such traffic 24 hours a day. When they are not occupied by lunatics, 14.313MHz or 14.300MHz are good frequencies to check for this activity. A short list of some of the more active net frequencies is given in **Table 1**. Check them out. You may be surprised how well this type of mobile whip or backstay antenna can do when surrounded by hundreds or thousands of miles of highly conductive sea water!

You may wonder why you cannot use a dipole on board and avoid all this ground foil and installation. Well, of course you can if you have the clear space in which to hang it and are interested in one band only. Multiband dipoles of the trapped variety are really not a good idea in a marine environment and would almost certainly not perform any better than the backstay. Some boating hams do carry a 15m and 20m dipole on board as an emergency backup in case of dismasting or shipwreck; but these would probably be the same ones who would carry climbing irons and a safety belt to shinny up the palm trees to hang their skywires!

Number 382 on your Feedback card

Board Creation Tips

Seven steps to beautiful PC boards.

Jeff Johnson KC5AWJ
17423 Landon Oaks Dr.
Houston TX 77095
[kc5awj@stevens.com]

If you've never created your own printed circuit board, here's the first thing you need to do: Find someone comfortable with etching boards and coerce him into mentoring you. It helps if your victim is also a ham—and people with darkrooms, safelights, and developing lights are good candidates. Also, look for orange-yellow fingers—the sign of a ferric chloride user. Once you've done your arm-twisting, proceed to:

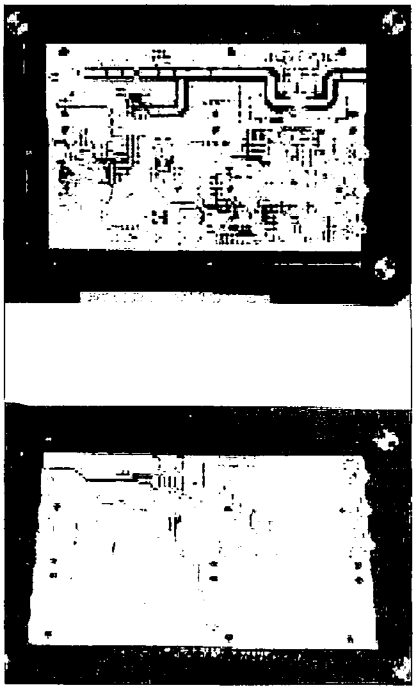


Photo A. Glass "sandwich" with artwork positioned and taped.

• Step 1. Have negative images of *both* sides of your artwork made by a commercial graphics company (about $6 per 8- x 10-inch image). It is very important that these negatives be made to scale. Things don't work very well if the artwork is the wrong size. These images should also be made on the bottom side of the film—so that the image will be against the pre-sensitized copperclad rather than 5 to 8 thousandths of an inch above the copper.

• Step 2. Gather supplies. Pre-sensitized negative-resist copperclad board, 4 x 6 inches, with 1-oz. copper foil on both sides, sensitized on both sides. I usually buy a board kit that includes the board and developer for that board (KeproClad™). One pint of ferric chloride (can be used till it doesn't work—CAUTION! *Don't* dispose of it in a septic tank system) should be adequate. Nickel, silver, or tin plating solutions are optional. You'll need a glass or plastic flat-bottomed container, large enough to hold the board flat in the various solutions. A double-boiler or a microwave can be used to heat the solutions to optimum temperatures (do not boil solutions; *warm* them to a maximum of 110°F). A safelight (a yellow bug light works), used to align the artwork to the board, and a developing light—used to expose the resist, are recommended items. I also have two 8- x 10-inch sheets of clear glass to "sandwich" the two pieces of film and the board together (**Photo A**), masking tape, transparent tape, and scissors.

• Step 3. Read the labels. Remove children and pets from the work area and the chemicals. I do my board etching in the garage with the light switch taped over and all the doors shut. Pre-sensitized board is not extremely sensitive to normal house lighting but direct sunlight MUST be avoided. Thirty seconds of direct sunlight is equal to four to six minutes of exposure under a developing light (i.e., completely exposed). Sunlight can be used to expose resist, but I prefer a more controlled environment.

• Step 4. Set up your work area. Turn off normal lights and use a safelight or bug light to prepare the artwork "sandwich." Target mark decals outside of the board area are used to align the two sides of the artwork with each other. They are not symmetrical, to ensure that the artwork is not backwards. Expose the "sandwich" for the time recommended by the board manufacturer for the developing light you are using, once on each side. Working under the safelight, separate the sandwich, remove the protective film from both sides of the board (hold the board by the edges) and place it in the developer solution. A small sponge is usually provided, to gently scrub the board while it is in the developer solution. Remove the board from the solution when all the artwork becomes visible. Save the used developer. At this

point, normal lighting can be used. Rinse thoroughly and dry the board. The next step is to "pickle" the board in etchant. Developer and etchant chemicals will react if mixed together. Place the board into the etchant bath for 15 to 30 seconds. Remove and rinse it. The copper areas will be a dull pink if the resist has been fully developed. Rinse and dry the board. Return the board to the developer bath for 15 to 30 seconds if there are any shiny copper areas. Rinse and dry the board. Etch the board in ferric chloride solution—agitate thoroughly, keeping everything in the container where it belongs—till all the copper areas are gone and the traces look like the positive-image artwork. Rinse thoroughly. NOTE: Ferric chloride permanently stains clothing. Forever. It will *eventually* wash off your skin. I try to be neat, but I always wind up with at least one spot somewhere. Wear your grubbies and work on a surface that can tolerate chemical spills.

• Step 5. Drill the holes. Most of the holes look like donuts. Drill the "hole" out. The majority of the holes can be drilled using a .031-inch to .035-inch drill bit. Vias can be drilled using a .040-inch bit. The larger holes are .050-inch (voltage regulator leads and power wires), .067-inch (RCA connector center pins), .078-inch (fuse holders), and .125-inch (mounting holes and RCA ground leads).

• Step 6. After all the holes have been drilled, the board trimmed to size, edges sanded, etc., remove the etch resist covering the copper. Resist stripper (Kepro DFS-12G for dry film) can be used, or the developer saved from Step 4 will work, with a little extra effort. Place the board in heated developer solution for 5-10 minutes to soften the resist. Gently scrub the board using a nonmetallic scrubbing pad (mine's a Scrunge™), using the solution to rinse and lubricate the board. Continue until all resist is removed. Rinse with clean water and dry.

• Step 7. Additional plating can now be done, or use the board "as is." Tin and silver cold plating solutions are available. Solderability can be improved by additional plating, but most hobbyists overcome poor solderability by using a more aggressive RA (rosin, activated) flux—an option not as available to commercial board assembly houses due to cleaning equipment requirements and hazardous waste disposal. 73

NEVER SAY DIE

Continued from page 5

and beating the game? It means making changes in your food, water, work, and TV watching, so maybe it's better just to get angry with me for bringing it up and forget the whole thing.

Why doesn't that crazy Wayne stick to writing about ham radio? This is supposed to be a ham magazine, isn't it? Alas, ham radio, like all of the other amusements offered to keep us quiet, is far too seldom used as a way to have fun while learning and just as a way to have fun. Far too small a percentage of hams are busy pioneering and learning about new modes or bands. Otherwise I'd have more articles for *73* trying to get you involved.

We're awash in amusements, for the mind and body. It helps keep us from learning about and then challenging the system. For the body we have a long list of destructive foods which taste good—like most fast foods, snacks, and desserts. We have mind-numbing drugs such as alcohol (a.k.a. beer), tobacco, and the harder stuff. We have endless entertainments to keep us busy—watching sports, soaps, movies, and sitcoms, listening to the radio, bowling, golf, and so on.

Our daily lives are full, between our sucker work (and that includes commuting), our family (which we are almost all seriously screwing up), our sucker meals (you really should know better than to ingest the crap you've been eating and the poisoned water you've been drinking), and large screen home theater entertainment, complete with a PrimeStar™ dish. And the Internet (I almost forgot *that* incredible time-waster).

When I got the job as editor of *CQ* in 1955 I was amazed and dismayed when I got to know more and more of the ARRL directors to find out in what deep contempt they held the members who had elected them. "Dumb as stumps," they explained. They laughed about the League's façade of democracy.

But it's the same in Washington, where our "leaders" have the same contempt for the public (you). In this case it's more of a mutual contempt because we know Congress and our political leaders are on the take. We *know* they're taking lobbyist bribery money to run TV ads which will guarantee their reelection. We *know* they're using media consultants, ad agencies, pollsters, and spin doctors to manipulate us, and we, like sheep, oblige by being manipulated and reelecting them. Our politicians know how easily we can be manipulated by things like prayer in the schools, abortion, flag burning, and environmentalism, where emotions rule over reason.

Sucker. Hmm, now where did you put those golf clubs?

So, are you mad at me? Well, am I right, or am I exaggerating?

Heck, you don't even own your home or the land it sits on. The state owns those and rents 'em to you with what is called property taxes. How about your car? Do you even own that? Try not paying your taxes on it and see. Or the license tag "registration" tax.

So what can you do about all this? Right now your politicians are semi-listening to you via opinion polls or, if you are a member of a vociferous organization like AARP, NRA, etc., they hear that one-sided view. Other than that you have no connection with them, despite the marvels of modern communications. Mail, faxes, phone messages and E-mail are either totally or completely ignored—unless you back them up with a bribe (a.k.a. reelection campaign donation), in which case you'll at least get an evasive answer. Joining a militia group isn't a good answer either.

The best bet is to understand what's going on so you can beat the system, then perhaps you can help me teach others to do the same. The upside is a longer, healthier, happier, wealthier life. The downside is you have to change almost everything you believe. It's easier to just get mad at me. Shoot the messenger.

Books

Even though I provide a good list of sources for buying the books I review in my guide to "Books you're crazy if you don't read," and I explain in bold type that I am *not* selling these books ("Oh, Wayne's just trying to sell books"), I still have readers trying to order them from me or Radio Bookshop. Tut.

I started the Radio Bookshop back in 1958 when I was the editor of *CQ*. That's a contest-oriented ham rag, in case you're not familiar with it. When I took on editing the magazine in January 1955 at a marginal salary it was with the understanding with publisher Sandy Cowan (not a ham) that if I got it into the black that I would have a share in its success. It was losing around $20,000 a month at the time. By the October issue I had it making money and running 128 pages instead of 64.

By 1958, with the money rolling in, I asked Cowan about the sharing he'd agreed to. He pleaded poverty. Maybe next year. So I asked for a half page of free advertising in the magazine so I could sell books to hams to make some extra money. No problem. I think the poverty plea was honest because I found out later that he was taking the profits from the magazine to buy a 60-foot yacht.

Over the last almost 40 years the Bookshop has done well when I was running it personally, but whenever I've turned it over to an employee to run it's managed to lose money. I never was able to find anyone who would take enough interest to see that we stocked good new books and kept the better sellers in stock.

Cowan and I split when, in January 1960, with him owing me a year's pay and owing my columnists and authors over a year for unpaid articles and columns, my assistant editor made a copy of the company's 1959 financial statement which showed that *CQ* had made over $1 million in profits that year. The capper came at Christmas when Cowan gave me a $5 Christmas bonus, saying it was all he could afford.

I tried working for an advertising agency, but didn't enjoy it. So I sold everything I could and got together just barely enough money to put out the first issue of *73*.

Now, back to the Bookshop. Unless books are advertised and promoted, like anything else, they don't sell. Book stores are not libraries, so if a book doesn't sell fairly quickly it's sent back to the publisher for credit. That's why Barnes & Noble are able to sell remaindered books so cheaply. Publishers print, say, 50,000 of a new title. Around 20,000 of them may be actually sold, which pays for the project. The 30,000 remainders are sold at $1 or less each to B&N, Crown, and other such outlets, just to get rid of them. Well, it beats selling them as waste paper.

Oh, the publisher saves a few copies for any possible later demand, so for a while Barnes and Noble can order a title from the publisher for you—until it's out of print.

Which brings me to libraries. They're limited by their shelf space, so if a book isn't active it eventually gets sold. I keep an eye open for library sales, picking up some excellent books for around 10¢ to 25¢ each that way. A few years ago I wanted to help out the Peterborough Town Library (the first free public library in the country), so I went through my book collection and picked out a few hundred titles I didn't need any more and donated them. You guessed it—I was able to buy most of them back for 10¢ each a couple years later at their book sale.

Yes, I could make money selling many of the books in my review guide. I could, if I could find someone to run the business. I sure don't have the time, and at this time of my life I'm not going to do *anything* just in order to make money. Of course, thinking back, there have been very few businesses that I've gotten into just as a way to make money. Like almost all entrepreneurs, it's the challenge of doing something, not the money involved, which has always excited me.

Viva CW!

A nice article on how to get involved with CW came in from W6BNB. Bob was explaining how much fun it is to communicate via a key. Hmm, let's see: Novices are plugging along at five words per minute. Generals and Advanced licensees are up to around 12 wpm. Yes, this almost got me to thinking.

The article ran almost five typewritten pages. At 12 wpm it would take someone three and a half hours (with no errors and with remarkable bladder control) to transmit it, and three and a half to copy it on the receiving end. Unless someone is reading-challenged they should be able to read the story in about two minutes. Slow readers might take up to eight minutes. Tsk.

Voice ambles along at around 150-200 words per minute, or around 16 times faster than a 12 wpm CW contact. Twelve minutes to read the story aloud.

My editorial each month, which runs around 7,000 words, would take ten hours to transmit (and receive), not counting meals and pit stops. I'd rather scan it into my computer and send it automatically.

My thought is that at 12 wpm, this sure is a painfully slo-o-ow way to c-o-m-m-u-n-i-c-a-t-e. Yes, it's faster than smoke signals and the snail, but just barely. No wonder voice communications has grown to be so popular, with CW pretty much relegated to the small minority who enjoy it. No wonder we're the only ones using CW any more. It's slow, error-prone, and limited in throughput by the skills of the sender and the receiver.

So how come the ARRL has so religiously fought every effort to eliminate the code from the license exams? Take a look at the organization's name for a hint. Radio relay. This harks back to the old spark days when distances were limited, so it was necessary to relay messages for them to cover much territory. This evolved into the ARRL's traffic system, where hundreds of ops acted like Western Union stations, soliciting messages from friends and sending them gratis. They happily originated, relayed, and delivered messages by the tens of thousands.

When RTTY came along in 1949 it was restricted to the VHF bands and the 11m ham band. A group of us petitioned the FCC to allow RTTY on the HF bands, but the ARRL fought it, worried that RTTY might replace CW for traffic handling. Indeed, in 1954 I set up a message center just off Times Square in New York so the public could send Christmas messages to their servicemen overseas. There was a *CQ* magazine cover photo of me with Skitch Henderson, Faye Emerson and Bill Halligan at the message center. We took thousands of messages from the public and relayed them on 2m from midtown Manhattan out to Long Island, where they were sent via the HF traffic nets to Antarctica, Europe, and Africa.

Eventually, despite the League's every effort to prevent it, we got the FCC to okay low-band RTTY, but it never caught on with the League's traffic nets, despite a throughput (at that time) of 60 wpm with zero errors as compared to the usual CW net 15 wpm.

Instead of remaining frozen in the 1930s we should be pushing for higher and higher throughput on both the HF and VHF bands. With the Internet rumbling along at 28 and 56kbps, that's 1,000 words per second or 60,000 words per minute. Well, that's over telephone lines, so we should be able to do at least that well via amateur radio. Instead it's taking us about three and a half days, day and night with no pit or hamburger stops, to put through 60,000 words via CW instead of one minute. Snore.

At that throughput we wouldn't have to transmit very long to communicate the average ham message. A half second blast would keep the receiving op busy reading for at least a couple of minutes, and then another couple to type out a return message. That would enable a hundred or more QSOs to be handled just on one frequency.

And I don't remember where I put my key. Darn!

Cancer!

The cellular phone industry, like the tobacco industry, is still doing its best to bury research reports showing a connection between cancer and their product. My thanks to Dr. Kelly VK4AOK for a clipping from an Australian paper reporting on research done with 200 mice, half of which were exposed to cell-phone radiation for two half-hour periods a day. Over a nine-to-18 month period, the exposed mice had 2.4 times as many tumors as the unexposed mice.

A significant increase in a form of B-cell lymphoma was evident early in the experiment, and the incidence continued to rise over 18 months, which suggests that the effects are cumulative and time-related. B-cells in the immune system are the key factor in over 85% of all cancers and infections. Mice are not men, but cells are cells.

All this merely confirms again the extensive research by Dr. Ross Adey K6UI, the pioneer in researching the effects of microwaves on human cells and the brain.

When powerful interests are threatened by research, as they have been with tobacco, EMFs, dental amalgam, root canals, aspartame, and so on, the lawyers and PR spin doctors get into the act, backed by an easily-bribed Congress and Administration, and

Photo A. W2NSD petting a friendly critter. Nope, you can't feed the animals ... but taking pictures is great fun.

it's the public that suffers. We're more expendable than the money.

Vanity, Vanity

I see where the FCC is planning to increase the vanity callsign fee from $30 for ten years to $50. It started out as $70. Big deal. At any of those prices it's a bargain.

Back in 1948, when I moved to Southern Pines, North Carolina, to take a job as an announcer at WEEB, the station owner explained after I'd gotten there that I'd have to get a First Phone ticket. So I took the train to Washington that night, arrived the next morning, took the test, and got my ticket. While I was there I asked 'em what callsign they were up to in the amateur division for the W4 area. "Oh, we're issuing W4NSA right now." "Stop the presses!" I yelled. The result was that I got W4NSD. Back then there was no problem with keeping one's suffix, if it was available. When I moved back to New York to work at WPIX as a cameraman I changed back to W2NSD.

In those days it was easier to change call prefixes than to do the paperwork required for portable operation.

When I moved to Cleveland to work for WXEL as a TV director I changed it to W8NSD. I remember the ARRL's Sweepstakes contest that year. For the first weekend I operated from Cleveland as W2NSD/8. On the second weekend I was back in New York operating as W8NSD/2, since my call change had arrived during the week. I had kW stations at both locations, so the only piece of equipment I used in common for the two contest weekends was my D-104 mike.

In 1962, when I moved to New Hampshire, I called the FCC to see if W1NSD was available. Well, it wasn't in use, but the FCC had stopped the practice of swapping call prefixes. However, if I'd hold on for a few months they expected their policies to change and I could get the W1NSD call. So I operated temporarily as W2NSD/1. And here we are 35 years later and I've gotten sorta used to being "portable 1." I see that W1NSD is still open, but what's the benefit in changing? The only call I'd pay $50 (or $500) for would be "W." I might settle for W1, remembering the fun I had operating JY1 for a couple of weeks from the palace in Jordan.

Hmm, I haven't had any real ham adventures for a while—I've got to get on the stick. No, I don't want to operate from Navassa again—twice was enough. Once we've got some sun spots going again and the DX is up, I'll have to look around.

Six Flags

Sherry, suffering somewhat from cabin fever, suggested we celebrate her birthday by making a trip down to New Jersey to visit the Six Flags™ amusement and game park. And while we're in the area, visit the Statue of Liberty. Well, heck, I'm so far behind in my work that another two or three days won't make much difference.

The only problem we had on the way down was getting to the Statue of Liberty ferry at Battery Park on Manhattan just in time to see the last ferry of the day (3:30 p.m.) leave without us. Oh well, we'll catch the old gal on the way back.

Our first event the next morning was the game park, where we drove through, being careful not to hit too many animals. That was fun, despite their having the more dangerous animals behind fences. It was fun having a great big deer come up and stick his nose in my car window so I could reach up and scratch his ears. The giraffes, too, were right out there in the road begging for handouts from every passing car. Ditto the ostriches.

The last section of the Safari park had the baboons and they were busy swarming over the cars, looking for food. The car ahead of us, despite endless signs asking visitors not to feed the animals, handed out at least a dozen bananas to the baboons. It's fun having a baby baboon sitting on your rear-view mirror looking curiously in at you.

Next we headed for the amusement park. $7 parking fee in addition to the $35 park entry charge. Hmm. The weather couldn't have been better—sunny, but cool enough to need a light jacket. Alas, the park was a serious disappointment. It was dirty and seedy. I guess we've been spoiled by the Disney parks—we've visited 'em in Anaheim, Orlando, Paris, and Tokyo. The Disney rides are fun, the food outstanding, and everything is kept spotlessly clean. We found the food at Six Flags expensive, made more frustrating by long, slow lines (did they train their staff in Russia?), and not very good. We tried watching some of the free entertainments. Ugh! Most of the rides were $5, but they didn't look interesting enough to bother. We left, grumbling in disappointment.

The next morning we made two more trips through the game park, enjoying every minute of it. It takes over an hour to get through the place and, ignoring the endless warning signs to keep our windows closed, we didn't, so we got a ton of great animal pictures. One of the baboons capped the experience by sitting on the van roof and peeing down our front window.

On the return trip we caught the Liberty Island ferry from Liberty Park in New Jersey, thus avoiding the dangers of New York City. There was a very long, very slow line of people climbing the 384 steps to the crown, so we settled for an elevator ride to the top of the old lady's pedestal, where I took the required pictures of lower Manhattan. The ferry and the island were packed with kids. Thousands of kids, brought in by the bus loads.

We got back to the farm around midnight. The game park sure made the whole trip worthwhile. For Six Flags, if it was across the street, and free, I wouldn't bother going.

When I was a kid we lived across the street from the Washington Zoo, so I spent a lot of time getting to know the animals

and birds during the year we lived there, zooming around on my bicycle. Imagine being able to go to the zoo every day, if you want!

Avoiding Shots

Unless you've been so totally suckered into believing in the importance of immunization shots that you haven't read the Walene James book, *Immunization, The Reality Behind the Myth*, which I've both reviewed in my editorial and included in my guide to "Books you're crazy if you don't read," your next step is to ask what you have to do to avoid having your children (or grandchildren) given shots which do little good at best and can do serious permanent damage or kill them at the worst.

Before you decide that Wayne's off his rocker again, which is the usual explanation when what I report is in disagreement with what you've been taught to believe by our school system and the media, do me the courtesy of doing your homework. My goal is to learn what I can in order to help you live a better life. Unfortunately, much of what I've learned is against commonly held beliefs.

Continued on page 44

NEVER SAY DIE

Continued from page 43

You don't *have* to have your children inoculated. You don't *have* to be inoculated yourself. And you don't have to become a member of Green's Religious Cult to avoid shots. Yes, I know all about the school rules that require all kids to have shots. But what I know that you don't is that you don't have to obey those rules. You don't even have to accept shots in the military or for foreign travel.

For schools, all you have to do is supply a release form which requests an exemption from medical vaccines for your child because it violates the free exercise of your sincerely and consciously held beliefs—and that you assume full responsibility for your child's health, thus releasing the school from same.

There's a booklet that covers the subject thoroughly, explaining what to do (and what *not* to do—like try to explain, argue or reason with school or other public officials). It's *Immunization Exemptions* from Dorrance Publishing, 643 Smithfield St., Pittsburgh PA 15222. The 34-pager is $11, including s/h. ISBN 0-8059-3319-0.

Remember Miss America a couple years ago? She was made stone deaf by immunization shots. Other children are killed (a regrettable, but acceptable loss to the trillion and a half dollar medical industry), or come down with polio. I know that the major health problems of my life started soon after getting my childhood shots.

No, I'm not selling the book. I probably should, just to make it easier for you, but then I'd get the usual "Wayne's just interested in making money" crapola from people who have been too dumbed down by the system to think for themselves.

Water

Are you and your family still drinking tap water in spite of my editorials? A recent newspaper article sent in by a reader pointed out that the sodium fluoride our government is putting in our water supplies and which we also get in some toothpastes can damage the central nervous system. "This damage can cause motor dysfunction, IQ deficits and learning disabilities. Harvard Medical School claims the poison can accumulate in the brain tissues. Researchers have claimed for years that fluoride is linked to bone cancer, hip fractures in the elderly, and in tooth decay."

Are you distilling the water you drink yet? I sure am! It's not a big deal to purify the relatively small amount of water you drink—a gallon or two a day per person. My latest Damark catalog lists the Genesis distiller at $180 (800-827-6767).

And what do you think the long-term effects of the chlorine they're using to kill germs in your water are doing to your body and mind? Chlorine is a poison. Are you really still drinking that stuff? Do you have some kind of a death wish? Hey, there are easier ways to get out of a lousy job than slowly poisoning yourself (and your family).

Then there's the copper from your pipes and lead from the solder joining the pipes, and so on. No wonder you're getting sick, feel so tired and can't think as well as you used to.

FCC News

There's a move afoot to make it easier for traveling hams to operate in the countries they're visiting, and for foreigners to operate here. Right now we have to apply for operating permits for every country we visit, which takes time and money. Having operated from over 60 countries so far, I can attest to the frustrations involved—the paperwork, the weeks it often takes, and the license fees.

When the agreements are all signed I'll let you know so you can take an HT and maybe an HF portable the next time you're traveling. I'll also let you know what countries are parties to the agreements, but it does look as if it's going to include most of Europe and the Americas.

Photo B. *Giraffic park.*

While on the topic of traveling, I've been amazed at how few people are using credit cards to pay for my booklets and for subscriptions to *73* and *Cold Fusion*. If you have a business you've got to be really dumb not to get an airline credit card and rack up free flying miles as you pay for as many business expenses as you can with the card. Plus your groceries, gas, and so on. Sherry and I have had Continental Airlines cards for years now and we've been able to fly first class to Europe once or twice a year just on the free miles. Who says it's expensive to travel? Only if you're not taking advantage of the opportunities.

We both like Continental Airlines. Yeah, they had some problems when they got started, but they go almost anywhere we want, and have given us no hassles. When we were doing more traveling we used to buy yearly (senior) passes on Continental (and Eastern before that) which allowed us to travel once a week anywhere in the country. That brought down my traveling cost to around $50 a flight! In the last year or so I've been so busy that I haven't had enough time to travel, so we've skipped getting the yearly passes.

Continental has done a nice job for us, with on-time departures and arrivals, no lost luggage, and decent meals.

Liar Liar

When I see a senator or congressman on TV telling us that campaign contributions don't in any way influence his actions or votes, why am I reminded of the lineup of tobacco executives swearing in that congressional hearing that tobacco is not addictive and does not cause sickness and death?

This is what came to mind as I read Article II, Section 4 of our Constitution. "The President, Vice President and all civil Officers of the United States, shall be removed from Office on Impeachment for, and Conviction of, Treason, Bribery, or other High Crimes and Misdemeanors." Bribery?

If it isn't for the purpose of bribery, what is the purpose of individuals and corporations "donating" millions of dollars for reelection campaigns? Corporations are not known for throwing away money. They invest it.

I plead guilty myself. In the past I've donated $100 or so to election campaigns and I've recommended you do the same thing. And what did I expect in return? Quid pro quo? I expected to be able to get my senator or representative on the phone when I had a concern. I wasn't donating my money to be a good guy and help another good guy get elected—I had the expectation of my

Continued on page 56

ON THE GO

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

Ultra-basic mobile operations

I do a lot of traveling in my job, and getting in a little radio time helps pass the time and make the miles go faster. A five-hour drive on the interstate will pass much easier if I can talk with a few folks on the way. Since I often end up using rental cars, a handie-talkie is the radio of choice much of the time.

What do you need to operate comfortably on 2m or 440MHz when on the go? Obviously you need a radio, but like many aspects of this hobby, it's the peripherals which make the system work better and much more fun.

The first and most important item is a reasonable antenna. For an antenna, there are several choices. The rubber ducky type of antenna may be fine for use at the hamfest, but is pretty impractical for use in the car. Not only is the short flexible antenna marginal to begin with, but the auto body acts as a pretty effective radio frequency shield. Some people like the clips which allow you to mount the rubber ducky antenna so that it is outside the window. While this does eliminate much of the shielding, it is still only a rubber ducky. For use in the car, I prefer a magnetic-mount quarter-wave antenna. If you remove the antenna from the base, it can easily fit in most suitcases. There are a number of these units which can operate on both 2m and 440MHz, although those that claim to be "gain" antennas tend to be a few inches too long to fit my suitcase. In any case, check the antenna out before you pack it for the trip. I usually do a quick continuity check to make sure that the center conductor and braid are not shorted, and that there is continuity from one end of the antenna to the other.

Make certain that the threads of the antenna are clean. I once bought a dual-band magnetic-mount antenna while on a trip and set it on the roof. It operated extremely poorly, and when I packed it into my suitcase I realized that the threads had been painted and were effectively insulated from the base. Set the SWR using your own car; this should be close enough for most other vehicles. In any case, it will beat the alternatives. Installation only takes a moment once you get to the car, and it can be tucked back inside the car when you park. A couple of suggestions might make this choice easier.

First, when transporting the antenna in your suitcase, keep the magnet away from computer disks or audio tapes.

Second, use a piece of metal as a "keeper" to contain the magnetic field. A round cover plate from an electrical junction box can be obtained at any hardware store and costs less than a dollar. This not only helps contain the magnetic field, but also helps the magnet retain its strength. Don't forget to remove the metal plate before putting the antenna on the car.

Third, try to attach the antenna to the center of the roof and try to minimize dirt, moisture or snow from the location where the antenna will be mounted.

Finally, I usually bring the coax in through the right rear door so that it is not kinked sharply. A center conductor which is braided will be less likely to break than a single conductor. When bringing the wire into the vehicle, do not coil the excess as this will form a coil which the antenna designer did not include in his or her calculations.

For use outside the vehicle, I like to take either a flexible quarter-wave, which mounts on the handie-talkie, or else a telescoping five-eighths wave. Sometimes the nearest repeater is located quite a distance from the hotel where I plan to stay, and the rubber ducky isn't enough. A J-pole made from a section of television twinlead is also useful, especially if you're going to be at one location for a while. The J-pole can be hung from the curtain rod in the hotel room with a small hook or string. It also has the advantage of being able to be rolled up into a very small package.

Power is always a consideration, of course. When traveling, I tend to use the HT's battery packs, and recharge them in the evening. A spare battery pack is important, as is the charger. Although I have a rapid charger, when I travel I only take the trickle charger. Most of these are the "wall wart" variety, which incorporates a plastic box containing the transformer that plugs directly into the wall. If you're traveling and don't use hard-sided luggage, there is always the risk of the plug getting bent during baggage handling. One way to prevent this is to use the type of receptacle found on extension cords as a plug cover. Cut the wire flush with the receptacle, then plug the charger into the receptacle.

"If an emergency vehicle is using its siren, I want to be able to hear it!"

I have also had handie-talkies which had drop-in power units that could fit over the glove compartment door. These not only powered the rig, but also could trickle-charge the battery pack. They usually plug into the cigarette lighter and some even have a small light to illuminate the face of the handie-talkie. Obviously, a hand-held microphone is important if using this type of power supply.

In the car, unless you're using a drop-in charger, it's easy to use the HT as a microphone, but small units have incredibly small speakers. At highway speeds, the sound is terrible. A small external speaker can often be found for less than $10 and will make operating much easier. While I sometimes use headphones with an attached microphone for portable operation, I prefer using the external speaker in the car. In some states, wearing headphones while driving is illegal. In any case, if an emergency vehicle is using its siren, I want to be able to hear it—or any other traffic hazard for that matter.

Finally, for VHF and UHF operations, you will need to know which frequencies are available at different locations. The repeater directories have come a long way in the past few years, and each type has its advantages and disadvantages. The atlas type of directory is easier to use, particularly if you're not familiar with the area. On the other hand, I've run across areas where some repeaters were omitted. The pocket-sized directory is more complete and has additional information about the repeater capabilities.

I tend to write repeater frequencies on the map I plan to use. If it's an area I pass through frequently, I may highlight my favorite, but I leave the others listed. You never know when you may need directions or assistance, and the preferred repeater isn't working, or no one responds. My favorite maps for these purposes are the ones the auto club uses, which are bound into a small booklet for a specific route. Naturally, I tend to program appropriate frequencies into my HT's memory, but if I want to make a contact in a hurry, the map helps me decide which frequencies I want.

Some of the ideas in this month's column may be useful, not only to the traveler, but also to those who are new to the hobby and are getting started on 2m or 440MHz. For many of us, the handie-talkie was our first rig, and finances (or spouses) may tolerate the purchase of one radio, but balk at purchasing two or three. Hopefully there may be an idea or two here which will help you get a successful start. 73

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the November issue, we should receive it by August 31. Provide a clear, concise summary of the essential details about your Special Event.

AUG 2

CARLINVILLE, IL Computer Fair/ Hamfest '97 will be held by the Macoupin County ARC, Inc., at the Moose Lodge in Carlinville. New location: take I-55 exit 60, follow signs 5 blocks west of the square on Rt. 108, turn left on Alton Rd. and watch for signs. Gate time is 7 a.m.–noon. Setup is at 6 a.m. Adm. $3. For general and vendor inquiries, call *Tim Jones, (217) 627-2355.* There will be VE exams for all classes; pre-registration is required. Call *Bill Ogle NØAP, (217) 854-8261.* Talk-in on 146.82/.22.

COLUMBUS, OH The Voice of Aladdin ARC will host the 7th Annual Columbus Hamfest from 8 a.m.–3 p.m. at the Aladdin Shrine Facility, 3850 Stelzer Rd. From I-270, exit WB onto Morse Rd., go 1/4 mi. to Stelzer Rd., turn south. Vendor setup from 6:30–8 a.m. Free parking. Commercial exhibits, flea market, refreshments, door prizes, free seminars. VE exams, register at 9:30. Adm. $5 adults, children under 12 free. Indoor 6-ft. tables, $8; outdoor spaces, $3. Talk-in on 147.84(-). For further info, contact *Jim Morton KB8KPJ, 6070 Northgap Dr., Columbus OH 43229-1945; tel. (614) 846-7790 eves only.*

HOUGHTON, MI The 1997 Upper Peninsula Amateur Radio Convention, better known as the U.P. Hamfest, will be held at the City of Houghton's Dee Stadium facility, located on the downtown waterfront. Doors open to the public at 9 a.m. EDT. Vendors and persons selling equipment will have main floor access beginning at 7 a.m. EDT. Friday eve. access will also be available, although overnight storage will be at owner's risk. AC power by previous arrangement only. Tables are $6/full table, $4/half table. Contact *Roland Burgan KB8XI, (906) 482-2403; E-mail: [rburgan@up.net], Packet: [KB8XI @W8YY.#UPMI.MI.US.NA]. For lodging/camping/boating info, contact Keweenaw Chamber of Commerce at 1-800-338-7982, or on the Web at [http://www.portup .com/ mainstr/chamber/home.html].*

AUG 2 & 3

JACKSONVILLE, FL The 1997 ARRL National Convention will be held at the Osborn Convention Center in Jacksonville. Open to the public Sat., 9 a.m.–5 p.m.; Sun., 9 a.m.–3 p.m. The Greater Jacksonville Amateur Radio & Computer Show will host the event. Free parking in the main convention center parking lot. Setup 1 p.m.–6 p.m. Fri., Aug. 1st. Upgrade VE exams will be offered at 9 a.m. on Sun. at the convention site. A wide variety of programs and forums will be presented by ARRL staff and noted authorities of national stature. Banquet at 7 p.m. Sat. at the HQ hotel, the Jacksonville OMNI. A special rate of $69 per night is available to those mentioning the convention. Phone *(904) 355-6664 or 1-800-843-6664* for reservations. Reg. for the entire weekend is only $8, which includes parking in the main lot. For more info, visit the *Web site at [http://users.southeast.net/ ~jrmoore/hamfest.html]*, or write *Greater Jacksonville Hamfest Assn., P.O. Box 27033, Jacksonville FL 32205.* For swap table reservations, contact *Karl Hassler N4DHG, 2767 Scott Circle, Jacksonville FL 32223,* or phone *(904) 268-2302.* Tables are $25 ea. for the weekend. For commercial exhibitor space, contact *Vern Ferris KB4VPU, 356 Aries Dr., Orange Park FL 32073, tel. (904) 272-7250.*

AUG 3

BERRYVILLE, VA The 47th Annual Winchester Hamfest and Computer Show will be presented by the Shenandoah Valley ARC, starting at 6 a.m. at the Clarke County Ruritan Fairgrounds in Berryville. General adm. $5, children under 16 admitted free. Tailgaters, additional $7 per space. Commercial and indoor tables by reservation; contact *Irv Barb W4DHU, Rt. 3 Box 5385, Berryville VA 22611. Tel. (540) 955-1745; E-mail: [ibarb@visuallink .com].* A flyer and vendor's table form can be downloaded from *[http:/ /www.w3ic.com/inet/svarc/hamfest].* VE exams will be given by the Mountain ARC Teams at Cooley School, across from the Hamfest. Walk-ins are welcome. Register 7:30 a.m.–8:30 a.m. No exam fees. For more info on exams, contact *Leo Patterson KQ8E, (304) 289-3576; E-mail: [6815484@mcimail.com];* or call *Gay Rembold W3DFW at (301) 724-0674.* Talk-in on 146.22/.82 W4RKC.

MARSHFIELD, WI The Marshfield Area ARS will host their 6th annual Potluck Picnic and Swapfest at Wildwood Park, Marshfield WI, starting around 11 a.m. All are welcome. Talk-in on 147.180. Contact *Guy A. Boucher KF9XX, 107 West Third St., Marshfield WI 54449. Tel. (715) 384-4323. Packet: [KF9XX@W9IHW.WI.USA.NA]. E-mail: [guyboucher@tznet.com].*

PEOTONE, IL The 63rd Annual Hamfesters Hamfest will be held 6 a.m.–3 p.m. at Will County Fairgrounds (I-57 exit 327 East) in Peotone. Sat. setup 3 p.m.–11 p.m. Free overnight parking. Secured building. Main exhibition hall opens at 8 a.m. Flea Market electric hookup fee is $10. Electricity will cost $10 for 4 tables or less; electricity is free for more than 4 tables. One free ticket per vendor; all others, $4 in advance, $5 at the gate. For reservations, etc., contact *Dave Brasel NF9N, 6933 W. 110th St., Worth IL 60482.*

PORT HURON, MI VE sessions will be held 8 a.m.–1 p.m. by the Eastern Michigan ARC at St. Clair County Community College, in conjunction with their annual Swap Meet. QRP and DX forums and a QRP demo will also be featured. Adm. $3 in advance, $4 at the door. Talk-in on 147.3 and 146.52. Contact *Bob Hebert KB8WMW* or *Frank Forsyth W8XI* at *P.O. Box 611230, Port Huron MI 48061-1230; or E-mail to [kb8wmw@juno.com].*

RANDOLPH, OH The Portage ARC *Amateur Radio and Computer* Hamfair '97 will be held 8 a.m.–4 p.m. at Portage County Fairgrounds, in Randolph (State Rt. 44, 4 miles south of I-76). Unlimited free parking. Admission is $4 in advance, $5 at the gate. Indoor tables $10 ea., flea market spaces $3 ea. For reservations, tickets, or info, contact Joanne Solak KJ3O at (330) 274-8240. WAS-DXCC card checking will be featured, and ARRL officials will be available. Mobile check-in and info on 145.39(-)MHz and 28.390MHz. Deadline for advance tickets is July 15th. Make checks/ MO payable to *Portage ARC* and mail to them at *9971 Diagonal Rd., Mantua OH 44255.*

AUG 9

BARABOO, WI The 1st annual Circus City Swapfest will be held at the Sauk County Fairgrounds 7 a.m.–noon, rain or shine. Tailgate sales. Free parking. Admission $5 at the gate, $4 in advance. Tables $5 for 8 ft. (includes one admission). Electr. available. For advance tickets and tables, contact *Yellow Thunder ARC, 1120 City View Rd., Baraboo WI 53913.* Check the Web site at *[http://www.thelorax.com/ ~sschulze/hamfest.htm].*

TACOMA, WA The Radio Club of Tacoma flea market will be held at the Charles Wright Academy, 7723 Chambers Creek Road West, starting at 9 a.m. Adm. is $4 with 12-year-olds and under free. Overnight RVs $2 for self-contained, Friday night only. Commercial vendors contact *Alan at (206) 840-4947. For general info, contact Bill at (206) 584-1086; E-mail: [BShimmin@CompuServe.com].* Power is limited; first-come, first-served. Talk-in on 147.28(+). Mail reservation payments to *Radio Club of Tacoma, Box 11188, Tacoma WA 98411.*

AUG 9 & 10

ST. CLOUD, MN Hamfest '97 will celebrate the 75th Anniversary of the St. Cloud ARC, beginning with a banquet on Aug. 9th at 7 p.m. Call (320) 251-8008 for reservations and information. Sun. morning at Whitney Senior Center, there will be VE testing at 10 a.m. A swap meet will be held 8 a.m.–2 p.m. Call the number given above for table reservations. Talk-in on 147.015 or 146.94.

AUG 10

STICKNEY, IL The DuPage ARC's Hamfest Computer Show will be held 8 a.m.–2 p.m. at Hawthorne Race Course, 3500 South Cicero Ave., Stickney IL. All dealers will be in one air-conditioned exhibit hall. Commercial setup is Sat., 3 p.m.–6 p.m.; Sun., commercial and flea market setup at 6 a.m. Outdoor flea market spaces are free. All indoor space must be reserved. Advance tickets $4, $5 at the gate. Children under 12 admitted free. Handicap accessible. Talk-in on 145.250MHz.

For advance tickets, send check payable to *DARC*, and send with a business-size SASE to *DARC Hamfest '97, 7511 Walnut Ave., Woodridge IL 60517*.

AUG 14 & 28

FT. WORTH, TX VE Exams by the Lockheed ARC and the Kilocycle Club of Ft. Worth will be held for all classes at the Lockheed Rec. Area Facility, 2400 Bryant Irvin Rd., Ft. Worth, at 7 p.m. For details call *Ted Richard AB5QU at (817) 293-6745*. G.R.O.L. testing by appointment only.

AUG 16

BURFORD, ONTARIO, CANADA The Brantford ARC Flea Market will be held at Burford Fairgrounds on Hwy 53, 15 km west of Brantford, 9 a.m. to ? Adm. $5, children under 12 free. Vendor setup 7:30 a.m., $8 per table. Tailgaters $4. Free parking. Talk-in on VE3TCR 147.150(+). For table reservations contact *Richard La Rose VE3RLX, 153 Dunsdon St., Brantford Ont. N3R 6N3; (519) 752-2437. Packet: VE3RLX@VA3SME; E-mail: [rlarose@bfree.on.ca]*. Or write to *Brantford ARC, P.O. Box 25036, Brantford, Ont., Canada N3T 6K5*.

LONGVIEW, WA The Lower Columbia Radio Assn. (W7DG) will sponsor its 6th Annual Ham Radio, Computer & Electronic Equip. Swap meet, 9 a.m.–3 p.m. at the Cowlitz County Fairgrounds In Longview. Adm. $3. Swap tables are $12 before Aug. 2nd, $15 after. Commercial tables $15. Free parking, overnight RV parking on the fairgrounds for $10, electrical hookup available. Vendor setup Fri., 5 p.m.–9 p.m.; Sat., 6 a.m.–8:45 a.m. Talk-in on 147.26(+), pl 114.8. Take exit 36 or 39 off Interstate 5 and follow the signs west for the county fairgrounds. Mt. St. Helens and the Oregon coast are nearby. For more info, write to *LCARA Swap Meet, P.O. Box 906, Longview WA 98632;* or call *Bob KB7ADO, evenings, at (360) 425-6076*. Or E-mail to *[KB7ADO@aol.com]*.

ROANOKE, VA A Hamfest/ Computer Show will be held by the Roanoke Valley ARC, Sat., Aug. 16th, 9 a.m.–5 p.m. at the Exhibit Hall, Roanoke Civic Center, Roanoke VA. Setup at 6 a.m. with help available. Features include equip. dealers, free forums, two walk-in VEC exam sessions, and an Indoor/outdoor flea market. Adm. is $5 at the door or In advance, outdoor tailgating $5, Indoor flea market tables $10 per table, dealer tables $20 ea. (plus $20 for electr.). Make checks payable to, and mail an SASE to *RVARC, P.O. Box 2002, Roanoke VA 24009*. Dealers and inside flea market contact *Claude KE4UVO, (540) 774-8971, or [ke4uvo@intrlink.com]*. All others contact *Terry AE4EW, (540) 890-6782 or [ae4ew@ix.netcom.com]*. Talk-in on 146.985(-).

AUG 17

CAMBRIDGE, MA A tailgate electronics, computer and amateur radio Flea Market will be held Sunday, Aug. 17th, 9 a.m.–2 p.m. at Albany and Main Sts., Cambridge MA. Adm. $4. Free off-street parking. Tailgate room for 600 sellers; $9 per space in advance, $10 per space at the gate. Includes admission. Setup at 7 a.m. For space reservations and further info, call (617) 253-3776. Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082*. Talk-in on 146.52 and 449.725/444.725 - pl 2A W1XM rptr. Sponsored by the MIT Radio Society and the Harvard Wireless Club.

PAULDING, OH The Paulding County AR Group, Inc. will hold their 7th Annual Hamfest at the Paulding County Fairgrounds on Fairgrounds Road. Free camping. Young hams under 12 admitted free with one adult. Setup at 6 a.m. Inside table $8, includes one gate; outside spaces, $5, includes one gate. General Adm. $3. Additional tables $5. Contact *Hamfest Chairperson, Jerry KB8MAF, PCARG Inc., 10392 SR 500, Paulding OH 45879. Tel. (419) 399-4507 or E-mail: [jlrhod@Bright.net]*. Talk-in on 146.46/.46 simplex or 146.865/.285 rptr.

AUG 23

BRIDGEWATER, NJ The Somerset County ARS Inc. Annual Hamfest will be held at the Somerset County 4H Center on Milltown Rd., just off Route 202, 8 a.m.–1 p.m. Setup is at 6 a.m. Talk-in on 448.175 (-5) pl 141.3, 147.135(+.6) pl 151.4. Call *Pat N2CQM, (908) 873-3394*, or write to *SCARS, P.O. Box 742, Manville NJ 08835*.

AUG 23–24

WOODLAND PARK, CO The Mountain ARC will hold its 16th Annual Campfest at the Colorado Lions campgrounds (4.5 miles north of Woodland Park, on Hwy. 67 North). Follow the signs. This is a family event with picnic, camping, and fishing. Gates open for campers Fri. at 2 p.m. Camping and/or selling fee is $10 per night (no double fees). Advance, paid reservations are required for camping. Bring your own tables or tailgate. Talk-in on the 146.82 rptr. The Colorado Lions Camp is in charge of refreshments and no other food sales are permitted. Pot luck dinner around the campfire Sat. night at 5 p.m. Contact *MARC, P.O. Box 1012, Woodland Park CO 80866-1012;* or call *Don AAONW at (719) 687-3692*. Remember, this event is being held in Colorado High Country, so come prepared for the weather.

AUG 24

ADAMS, MA The Northern Berkshire ARC will hold their Annual Flea Market at Adams Agricultural Fair Grounds, beginning at 8 a.m. Setup for vendors is at 7 a.m. Vendor contact is *Joel Miller N1WCF, (413) 442-2653*. Talk-in will be on 146.910, the Mt. Greylock rptr. Prices are $6 for vendors, including one adm.; $3 for shoppers with adm. for the first person; and $1 for each additional person. Pre-reg. for vendors secures a table, if needed. Tables will be available on a first-come, first-served basis the day of the event.

YONKERS, NY A Hamfest/ Computerfest will be sponsored by the Yonkers ARC at the Yonkers Municipal Parking Garage on Main St. in Yonkers. Buyers: 9 a.m.–3 p.m., sellers: 7:30 a.m. No VE exams. Pre-reg. $10 per space, AC power available with pre-reg. $14 at the door. Buyers: $5; XYL, YL, and kids under 12 free. Make checks payable to the Yonkers Amateur Radio Club, and mail to *Y.A.R.C., P.O. Box 378, Centuck Sta., Yonkers NY 10710-0378*.

AUG 31

DUBUQUE, IA The Great River ARC, Iowa Antique RC and Historical Society, and the Tri-State Computer Users Group will sponsor a Hamfest/Radiofest/Computer Expo August 31st, 8 a.m.–2 p.m. at the Dubuque County Fairgrounds on Old Highway Rd., west of Dubuque. Features include free parking, dealers, flea market, tailgating, and VE exams at 10 a.m. Adm. is $3 in advance, $5 at the door; 12 and under admitted free. 8 ft. tables are $8. Talk-in on 147.84/.24. Contact *Loren Heber NØYHZ at (319) 556-5755; Jerry Lange KBOVIK at (319) 556-3050; or Jerry Ehlers NØNLU at (319) 583-1016*. Write to *G.R.A.R.C., P.O. Box 546, Dubuque IA 52004-0546*.

SEP 6–7

AUSTIN, MANITOBA, CANADA The Manitoba Amateur Radio Museum will host Its 3rd Annual Ham Fest on the grounds of the Manitoba Agricultural Museum in Austin. For details write to *Manitoba Amateur Radio Museum Inc., 25 Queens Crescent, Brandon, Manitoba, Canada R7B 1G1*.

LOUISVILLE, KY The Greater Louisville Hamfest/ARRL KY State Convention will be held at the Kentucky Fair & Exposition Center, all indoors. Tickets $6 for both days, Sunday $5 at the door. Send advanced ticket registration with an SASE. Mail requests for tickets and info to *P.O. Box 34444-Q, Louisville KY 40232-4444*. Commercial vendors call *(812) 948-0037 or (812) 282-7007*. For flea market spaces call *(812) 282-4898 or (502) 935-7197*. Check the Web page at *[http://www.thepoint.net/~GLHA/]*.

SPECIAL EVENT STATIONS

AUG 1, 2 & 3

OSHKOSH, WI Members of the Fox Cities ARC will operate W9ZL from the Experimental Aircraft Assn. Fly-In and Convention In Oshkosh. Operations will be on the General phone portions of the HF bands, as well as RTTY and CW, as conditions and operators permit. The club will also be giving "on grounds" convention information (no QSLs please) on 146.520 simplex. Proper QSL and SASE only, to *Wayne Pennings WD9FLJ, 913 N. Mason St., Appleton WI 54914 USA* for a special 8" x 10" picture certificate.

AUG 16

TAMA, IA The Tama ARS will operate WDØGAT 1500Z–2300Z Aug. 16th, to celebrate the 100th Anniversary of Lennox Manufacturing. Operation will be in the General 80–15 meter phone, Novice 10 meter phone, and 2 meters. For a certificate, send your QSL and a 9" x 12" SASE to *TARS/WDØGAT, P.O. Box 94, Montour IA 50173 USA*.

AUG 16, 17 & 18

ENGLEWOOD, NJ The Englewood ARA, Inc., invites all amateurs the

world over to take part in the 38th Annual New Jersey QSO Party, 2000 UTC Sat, Aug. 16th–0700 UTC Sun., Aug. 17th, and from 1300 UTC Sun., Aug. 17th–0200 UTC Mon., Aug. 18th. Phone and CW are considered the same contest. General call is "CQ New Jersey" or "CQ NJ." NJ stations identify by signing "De NJ" on CW and "New Jersey calling" on phone. Frequencies: 1810, 3535, 3950, 7035, 7135, 7235, 14035, 14285, 21100, 21355, 28100, 28400, 50–50.5, and 144–146. Phone on even hours; 15/10m on odd hours (1500 UTC–2100 UTC); 160m at 0500 UTC. Exchange QSO number, RST and QTH (state/province, or country). NJ stations' QTH is their county. For more information, write to *Englewood ARA, Inc., P.O. Box 528, Englewood NJ 07631-0528 USA.* Include a #10-size SASE. Stations planning active participation in New Jersey are requested to advise EARA by Aug. 1st. Portable and mobile operation is encouraged.

AUG 30–31

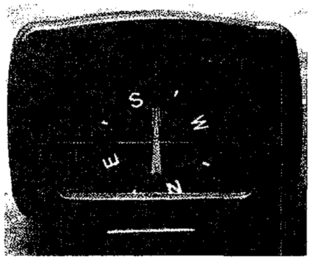
BOWLING GREEN, KY Station N4HID will be operated by the Western Kentucky DX Assn., 0100 UTC Aug. 30th–2400 UTC Aug. 31st, in recognition of the contributions made by animals to science, and for their companionship with mankind. Operation will be on 7330, 14280, 21380 and 28580MHz. Certificates will be available. Send name and address to QSL to *Ed Gann N4HID, 445 Elrod Rd., Bowling Green KY 42104 USA.*

AUG 31

THOMSON, IL The Palisades ARC and 90 West DX Assn. will operate Station W9BPT, Aug. 31st, 1700Z–2100Z, to celebrate Thomson Melon Days. Operation will be on the lower portion of the General 40 and 20 meter bands. For a certificate, send QSL and 9" x 12" SASE to *Bob Plumley K9IEG, 1123 West Main St., Thomson IL 61285 USA.*

Number 49 on your Feedback card

UPDATES



No, *this* way ...

Readers of Joe Moell's "Homing In" column in July may have noticed an anomaly. Here is **Photo A**.

Wanna talk to a real person?

At the end of "Build the Mag-Glass," on page 23 of June's *73*, the telephone number for ordering Neodymium iron-boron magnets from Marlin P. Jones and Associates is actually their FAX/automated ordering number. If you want to interface with a human face, call: (800) 652-6733.

Number 88 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the November 1997 classified ad section is September 12th, 1997.

TIRED OF IRONING? PCB service. No $ setup, free scanning available. **FIRST PROTO,** 4201 University Drive. #102, Durham NC 27707. (919) 403-8243. BNB5005

HEATHKITS WANTED: Premium Prices paid for unassembled Heathkits. Rob W3DX, **(804) 971-6812** evenings or [Robcap@aol.com]. BNB206

METHOD TO LEARN MORSE CODE FAST AND WITHOUT HANGUPS Johan-N3RF. Send $1.00 & SASE. **SVANHOLM RESEARCH LABORATORIES,** P.O. Box 81, Washington DC, 20044 U.S.A. BNB421

FM MICRO/LOW POWER BROADCASTING 88-108MHz. PLL Transmitters/R.F. Amplifiers/Antennas. Mono/Stereo, 50 mW's to 100 Watts. Free *Catalog/* Info Call (250) 642-2859 or E-Mail: kscott@pinc.com. **R. Scott Communications Ltd. We Ship World Wide From Canada!** BNB102

MAHLON LOOMIS, INVENTOR OF RADIO; by Thomas Appleby (copyright 1967). Second printing available from **JOHAN K.V. SVANHOLM N3RF,** SVANHOLM RESEARCH LABORATORIES, P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. BNB420

RF TRANSISTORS TUBES 2SC2879, 2SC1971, 2SC1972, MRF247, MRF455, MB8719, 2SC1307, 2SC2029, MRF454, 2SC3133, 4CX250B, 12DQ6, 6KG6A, etc. **WESTGATE**, 1-800-213-4563. BNB6000

CUSTOM DIAL COVERS/CLOCK LENSES (HAMMARLUND, ETC.) $10.00 PPD. Send bezel, OLD or dimensions, make, model. **Bill Turner WAØABI,** 1117 Pike, Saint Charles MO 63301. BNB499

The Communicators HandBook A Reference guide for the professional engineer or Radio DX'er with A list of FREE catalogs and Much, Much, More!!.. To Order send $9.98 U.S. Check/M.O., Canada $13.50 int'l postal M.O. TO: **S. Crawford,** P.O.B. 83, Riverdale NY 10463. Fast FREE Shipping. BNB799

Audio Equipment wanted. 1930's - 1960's. Tube-type amplifiers, large or small speakers, mixers, microphones, tubes, parts, etc. Especially Western Electric, Jensen, Marantz, McIntosh, J.B.L., etc. **1-800-251-5454.** BNB202

BREAK THE CODE BARRIER: A self-hypnosis tape that allows you to learn or increase code speed easily and quickly. To order send $14.95 + $3.00 S&H to **Dr. Hal Goodman,** P.O. Box 184, Eastport ME 04631. For more info. send SASE or [http://www.nemaine.com/w3uwh/morse.htm]. BNB2031

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone:** (616) 925- 5899, 8-4 ET. BNB964

CLASSIC RADIOS. RadioFinder web list revised weekly: [www.radiofinder.com] TEL/FAX **(313) 454-1890;** [finder@radio finder.com]. BNB700

ASTRON power supply, brand-new w/ warranty, RS20M $99, RS35M $145, RS50M $209, RS70M $249. Call for other models. **(818) 286-0118.** BNB411

Number 50 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041-0099
[carrjj@aol.com]

Let's do a few things this month. We will continue (briefly!) the discussion on ham software, we will look at radio astronomy and related topics, and then we'll mention a nationwide QSO party for those who like contests.

Software

Golly day, it's interesting reading E-mail after publishing a "controversial" (?) article like my software rant. For those who came in late, I have bemoaned the lack of professionalism in a lot of ham software. I also bemoaned the fact that so much of it is in the obsolete MS-DOS format, rather than Windows®. Wow! What an interesting time reading E-mail after that article appeared.

One guy wrote: "Right on, OM! I bought (remain nameless) from (so-and-so), and it was a DOS program ... Like you said, it wouldn't run on my Windows 3.1 machine." The very next E-mail, immediately beneath it, came from the guy who wrote and distributed the offending software: "You are totally ignorant! I will continue to write DOS software ... My (remain nameless) program is well regarded and very popular ... it continues to sell." I should have forwarded the first guy's E-mail to him—one of his own customers was congratulating me.

I was also struck by the tone and shrill illogic of some E-mailers. One fellow made the absurd accusation that anyone with a Pentium™ computer and Windows 95 has to be rich, and only uses it to download pornography off the World Wide Web. Not me, thank you. My religious convictions and respect for my wife and kids say, "Don't go there."

Several people ranted against Bill Gates. I can't say that he's my favorite person, and I very much wish he had some old-fashioned competition. But does that mean I want to stay with an obsolete (Bill Gates) product? And then again, I could spite my face by cutting off my nose.

One fellow verged on abusive, but after we exchanged a few E-mails seemed to calm down. Others ... well, others did not respond so well. One chap made so many illogical, untrue, and just plain phony claims that I had to laugh. My response to him: "Sir, your opinion is yours to have by right, but recognizing your constitutional right to hold dear any opinion you wish does not mean that I have to overlook the fact that said opinion stands on the edge of a logical precipice that is simply too broad for the healthy mind to leap."

Radio astronomy

Hams are ideally situated to do some radio astronomy observation. Regular readers of this column know that one of my passions is getting new blood interested in amateur radio ... and if that new blood happens to be high-school- or college-aged youngsters, then all the better. Learning a bit about radio astronomy would serve to ease people into our hobby as well. Radio astronomy will, after all, fit nicely into the science curriculum of high schools, community colleges, and four-year colleges ... and might be of interest to their ham clubs.

The equipment and antennas of radio astronomy are very reminiscent of ham radio stuff (at least the receivers). If you would like to explore this topic, then here are some sources (some on the World Wide Web and E-mail):

Radio-Sky Publishing
P.O. Box 3552
Louisville KY 40201-3552
E-mail: [radiosky@radiosky.win.net]
Web site: [http://www.win.net/~radiosky]

Radio-Sky publishes several books, including a really good teacher's guide to radio astronomy. It's mistitled, however, because it is useful to nearly everyone interested in the subject. Also, the author of *Radio Astronomy Projects* (a Radio-Sky title), Dr. William Lonc, can be reached at:

E-mail: [lonc@husky1.stmarys.ca]
Web site: [http://apwww.stmarys.ca/~lonc/lonc.html]

One thing on Dr. Lonc's Web site is information on the 2m ham band beacon set up on Sable Island in the Atlantic by St. Mary's College in Nova Scotia.

Jeff Lichtmann has a catalog of supplies and books for aspiring radio astronomers:

Jeff Lichtmann
Radio Astronomy Supplies
190 Jade Cove Drive
Roswell GA 30075

Finally, the Society of Amateur Radio Astronomers (SARA) can be reached at:

Society of Amateur Radio Astronomers
Membership Services
247 North Linden Street
Massapequa NY 11758

If you are interested in the Search for Extraterrestrial Intelligence (SETI), then an amateur group might be of interest:

Dr. Paul Shuch N6TX
SETI League
P.O. Box 555
433 Liberty Street
Little Ferry NJ 07643
E-mail: [n6tx@setileague.org]
Web site: [http://www.setileague.org/]

You can also find a lot of material on the World Wide Web by typing in "radio astronomy" on your Web browser. Be sure to limit the search to sites that meet both words (some browsers like to see something like "radio AND astronomy", others have a check box).

Radio astronomy isn't the only activity that might possibly interest newcomers. I have coined the term "radioscience observing" to cover the entire range of activities involving the amateur science applications of radio: astronomy, SID/solar flare hunting (HF and VLF), Jupiter DXing, moonbounce, terrestrial propagation studies, and others. In fact, I am working on a book on this subject for Howard W. Sams (look for it late this year or early 1998). Radio astronomy and radioscience observing might be the "hook" to get some people interested in amateur radio.

U.S. Air Force 50th Anniversary QSO Party

In celebration of the creation of the United States Air Force on September 17th, 1947, the Headquarters, U.S. Air Force Directorate of Communications and Information, is sponsoring a QSO party for all interested radio amateurs from 0001 UTC 20 Sept 97 to 2359 UTC 21 Sept 97. All bands and modes.

Score contacts by "point identifier."

Stations with licensees with no Air Force affiliation have a point identifier of 1, are worth one point, and would identify with the suffix "Air Force One" on phone or "/AF1" on CW or digital modes.

If the licensee is a U.S. Air Force veteran, member, or retiree (of any component, active, Air National Guard, or AF Reserve), the point identifier is determined by subtracting the year the licensee entered the Air Force from 1997. For example, if he or she entered the Air Force in 1947, their point identifier is 50 (1997 - 1947 = 50), and they would ID "/AF50." If he or she entered in 1963, their point identifier is 34 (1997 - 1963 = 34), and they would identify "/AF34." Note that the duration of Air Force service is insignificant; the point identifier value is determined solely by the year the member entered the Air Force.

Obviously, the most sought after stations will be those brave men and women who entered the Air Force in 1947, whose point identifiers will be "50" and whose contacts are worth 50 points!

Scoring: Add total point identifiers for all qualifying contacts.

Multiple contacts: Stations may be worked multiple times on

QRP

Low Power Operation

Michael Bryce WB8VGE
P.O. Box 508
Massillon OH 44646
[73357.222@compuserve.com]

The 1997 Dayton Ham-Vention® is history. With excellent weather, although it was a bit cold on Friday, the crowds were out in full force. As usual, QRP operators from around the globe found their way to the Days Inn South.

FDIM

It was standing room only for this year's Five Days In May QRP sessions. Starting Thursday morning, the sessions covered just about every aspect of operating QRP. No matter what you may be interested in, from antenna design to designing your own Web page, it was covered during the FDIM sessions.

Plans are already in the works for next year's event. If you have never made it to the Dayton HamVention, you must clear the calendar for next year's FDIM.

Of course, even if you could not make the FDIM sessions held at the Days Inn, there were also QRP forums being held at the Hara Arena. They were hosted by the QRP-NE club, with Jim W1FMR as the moderator. So, if you wanted to learn more about QRPing, Dayton was the place.

Friday night, the QRP ARCI held its annual banquet. Our guest speaker this year was Martin Jue, president of MFJ Industries.

The QRP ARCI is pleased to announce that the following were inducted into the QRP Hall of Fame in 1997 for outstanding contributions to the QRP community:

Doug Hendricks KI6DS
Dick Pascoe GØBPS
Mike Czuhajewski WA8MCQ

All were present at the QRP banquet at Dayton to accept their awards. Previous HOF inductees were: 1992—W1FB, G3RJV, AA2U, W7EL; 1996—K8IF, W9SCH, W9PNE, WØRSP, W7ZOI, K1BQT, GM3OXX.

And from the president of the QRP ARCI, Mike Czuhajewski WA8MCQ:

"The QRP ARCI also presented plaques of appreciation to Mike Bryce WB8VGE, for his long work for the QRP ARCI in the thankless but difficult and critically important jobs of membership chairman and publicity manager, and to Myron Koyle N8DHT, for his years of work in running the rooms reservations which contributed greatly to the success of QRP Dayton."

I was happy to accept the plaque for N8DHT, who was unable to attend the banquet. A quick head count by me tallied up over 150 people in attendance—needless to say, it was sold out. Seems we are making some noise, because this year it took Pete over 30 minutes to give away the door prizes!

QRP operators not only like to play radio, they like to build radios as well. So Friday night, after the banquet, the QRP ARCI held its vendor night. Here vendors from around the world showed off their latest and greatest to the crowds.

New goodies to play with

While I can't possibility list all the vendors with all their new gadgets, here are a few that stuck out Friday night:

Wilderness Radio had their Sierra and Cascade rigs. And how about a noise blanker for your NorCal QRP rig? They also had their new BuzzNot noise blanker. It really works!

On hand, too, was the Wilderness KC2 LCD counter/keyer/S(C)meter/wattmeter. This widget does everything I just said and only draws 7mA doing it. You can add the KC2 to the Sierra or any other QRP rig.

S&S Engineering was showing off their new DDS VFO. If you've been planning on a analog VFO for a project, you should take a look at this microprocessor-based digital VFO.

Dave Benson also had on display his new "White Mountain" SSB transceiver. Right now, he has models for either 75 or 20 meters. Its small size—4.4 by 5.25 inches—makes the White Mountain one of the smallest SSB rigs I know of in kit form.

Dave also informed me that the popular Green Mountain series of superhet CW transceivers is now available on all the ham bands from 80 to 10 meters. This includes 30, 17, and 12 meters.

Kanga US was showing off a new multiband rig, but Bill did not have enough information about the new kit to share details. So, contact Bill at Kanga US to learn more.

There sure were a lot of "38 specials" running around at Dayton. Most could be seen Friday and Saturday night at the Days Inn. Although I can't say it with 100 percent certainty, I was told that as of Friday night, NorCal had sold over 1,700 "38 specials."

On hand were Atomic keyer kits, Rainbow antenna tuners, keyers, keyer paddles and microprocessor-based goodies of all types. Why, I even had a selection of QRP-sized solar panels.

One of the slickest projects I saw was a Wilderness Radio Sierra with an LDG microprocessor-controlled automatic antenna tuner. I'm sorry I did not make a note of the name or the call of the operator who did all the work. If you know, please drop me a note. It's the only Sierra "AT" I've ever seen!

One interesting comment my wife made to me was the name selection used by the various vendors for their products. She noted that rigs from W6 land were named after guns (the 38 special and the 45 automatic), while the stuff out of the east coast had names like the "White Mountain" rigs. What surprised *me* was that she noticed in the first place.

QRP ARCI news

Myron N8DHT has stepped down as secretary/treasurer of the QRP Amateur Radio Club International. Ken Evans WD4U of Lilburn GA is the new secretary/treasurer.

To renew your membership in the QRP ARCI, contact me at the address at top. *Do not* send renewal monies to Ken. If you would like to join the QRP ARCI, again, send your check to *me*. The current price of renewal is $15. New member with membership certificate is $17. Membership in the QRP ARCI is for life. The yearly dues are for *The QRP Quarterly*.

If you have a problem with your membership, I'm the guy to contact. If you have E-mail, that's the best and fastest way to let me know about your problem. My E-mail address is also at top. Don't contact Ken WD4U or anyone

the same band if the contacts are on different modes, but only once on each band if on the same mode. Stations may be worked and scored on multiple bands.

Send logs by 15 October 1997 to: K5HOG, Razorback Radio Club, 604 Julian Avenue, Honolulu HI 96818, USA.

Logs must have station worked, date, time, mode, band, and point identifiers for each contact. *Points must be totaled on each page to be accepted.* Neither accepted nor rejected log sheets will be returned unless accompanied by a suitable SASE.

Prizes: Trophy (plaque) with Air Force 50th Anniversary logo signed by the Headquarters, United States Air Force Director of Communications and Information (Lt. General William Donahue) to the overall winner. Certificates (signed and with AF 50th logo) to top three finishers in each state and country.

Questions to: Bernie Skoch K5XS, Colonel, USAF, Director of Communications and Information, Headquarters Pacific Air Forces, 604 Julian Avenue, Hickam Air Force Base, Honolulu HI 96818; E-mail: [75376.12@compuserve.com].

While this is not a Contests column by any means, I thought this one looked especially interesting. So, Go Air Force, Happy 50th Anniversary (which is a lot to say from a guy who works with Navy aviators)!

That's it for now. Please keep that snail mail and E-mail coming in, and no "DOS spams," please! To each his own (opinion, that is)! 73

Number 52 on your Feedback card

Ham to Ham

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
[dmiller14@juno.com]

You're invited to send me your tips, suggestions, ideas and shortcuts, as always, to the addresses shown above. I'm always in the market for new and interesting contributions like this first item.

The mysterious capacitor

From Ken Guge K9KPM: "I recently encountered what at first seemed a strange problem with my broadband VHF/UHF discone antenna. One of the beauties of the discone design is its very wideband frequency capabilities; this one (a commercially-made unit) is specified as usable on transmit from 2m on up through the 23cm ham band and with an even greater range of potential usability as a receive-only antenna.

"Over the winter, however, my discone's SWR rose dramatically (to over 3:1 at 2m). It reached the point where the antenna became virtually unusable for either receiving or transmitting. I first checked the indoor end of the feedline with an ohmmeter, and found that there was some measurable shunt resistance; this in an antenna that should have displayed a completely open circuit to DC. Going a little further, I also found that it was acting very much like a fairly high value capacitor ... about 3,000pF in fact! At 2m, that 3,000pF (.003μF) would be enough to effectively bypass all but the strongest of 2m signals to ground, working out to about an ohm of capacitive reactance at 144MHz.

"My first thought was that perhaps water had somehow worked its way into the coaxial (RG-8X) cable feeding the antenna, but disconnecting the coax at the far end, and repeating the measurements, proved conclusively that the coax itself was perfectly all right ... the problem had to be in the antenna. But what could go wrong with a nicely-machined, well-sealed antenna's main connection block? There was virtually no open gap for water to enter the connecting block from the sides or from above, yet disassembling the entire machined piece showed a considerable amount of internal corrosion and even a small amount of water itself. **Fig. 1** shows a side view of the basic construction of the antenna—not particularly complicated nor subject to this type of problem. What might possibly have caused this seemingly inexplicable condition to develop? The antenna's coaxial connector is facing downward—it was unlikely that water might have worked its way in via this route. Ditto for the rest of the discone's construction. There just wasn't any obvious way for moisture to enter in a liquid form—only via humidity in the air. Here's what I feel happened:

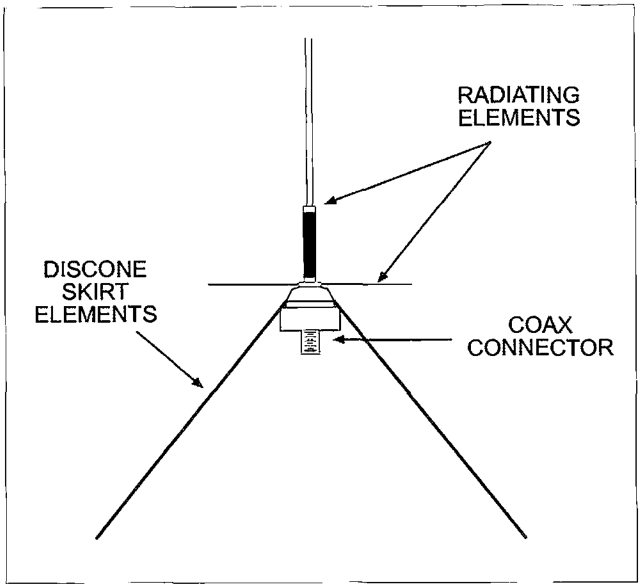


Fig. 1. K9KPM's discone antenna. The connector block is very weather-resistant, but not totally airtight. The coax cable connector is attached to the bottom of the block.

"The interior of the connection block has a small, hollow cavity, which, though not penetrable by rain, is subject to infiltration by moist, humid air (not being hermetically sealed). We have our fair share of moist, humid days in the Chicago area, often followed by quickly changing temperatures that can drop amazingly rapidly (sometimes 60 or 70 degrees in just a few hours). If moist air gets into the connector block's cavity, and then is subjected to a dramatic cool-down, the moisture in the trapped air will condense out in the form of liquid water. Several episodes of such a natural occurrence can cause a significant buildup of water inside a tight (but not perfectly air-tight) container. I feel that the discone's connecting block cavity was such a container. Over time, of course, the water worked on the surrounding metal pieces, causing severe corrosion and changing the pure water into something more like an electrolyte. That electrolyte, and the otherwise insulated metal pieces inside the block, resulted in a .003μF electrolytic capacitor being developed right inside my VHF/UHF antenna—isn't nature wonderful?

"Now here's the moral. If you live in a climate such as that found near Chicago, it might be best to consider either sealing relatively air-tight connections entirely, or, if that's not practical, leaving enough free-air circulation space so that air exchange can take place more rapidly when climatic conditions shift quickly. In that way, humid air has a chance to be flushed out before it can condense

---

else. I'm the only person who can modify the computer database holding the club's records.

FD photos

By the time you read this, those mosquito bites should have healed over. How about sending some FD photos to me? I'm sure the rest of the QRP world would like to see what the other guy's station looked like!

New QRP award

The 30 Meter QRP Millennium Challenge. In a nutshell, here's the basic idea:

The first person to work 200 countries (confirmed by QSL) using 2W RF (output) on the 30m band by the year 2000 will win a very (very!) nice trophy. This is not going to be as easy as it sounds. Working the required 200 countries is not that hard, but getting all the QSL cards is another matter. The deadline is January 1, 2000. Yes, I know there was no "zero" year, but the deadline remains January 1, 2000.

This is something I've been wanting to do for a very long time. Although many of the finer details have yet to be worked out, this should be enough to get everyone started. As they say, "the clock's ticking."

- To give everyone a head start, only contacts made after July 1, 1997, count toward the award.
- RF power output shall be no more than 2W.
- Contacts must be confirmed by QSL. QSL cards should indicate the QSOs were at QRP levels.
- Only contacts made on the 30m band count towards the award.
- Multi-mode contacts are fine, e.g., CW or any digital mode that does not use repeaters.
- The award is open to all licensed ham radio operators worldwide.

I'll be getting all my ducks in a row, and by the time this article hits your mailbox, all the details will be down. I also will send the rules to all the various clubs and magazines. Now, I wonder who will be the winner? ... 73

and deposit its water into the open cavity. In the case of my discone antenna, I chose to fill that open cavity above the bottom connector with Stuf™. It's a Teflon™-based grease that's compatible with electrical connections, and is made by Cross Devices of Cutchogue, NY. It's described as a dielectric waterproofing filler for coax connectors. I bought my tube of Stuf in Milwaukee, but it's probably available elsewhere as well. I packed the grease into the cavity of the connection block so that some of it actually oozed out when everything was reassembled and a new connector was installed, assuring me that the cavity would now be virtually airtight (or at least tight enough to prevent a similar occurrence in the future). We'll see.

"After reassembly, the antenna showed perfect continuity through the connection points and no shunt impedance whatsoever, so I'm reasonably confident that the job will hold. I hope that my experience may have some value to other readers who've encountered similar problems with outdoor connections. Remember to stick with it—there's an explanation for everything!"

Moderator's note: Ken is absolutely right when you stop to think about it. Any enclosure that's capable of trapping moist, humid air is a potential water reservoir, just waiting to happen, when a quick change in temperature takes place. Filling that reservoir with an RF compatible grease (such as he did), is probably the best insurance against an event like K9KPM experienced. Good tip, Ken!

Circular memory

From Frank Brumbaugh W4LJD: Here's an easy-to-implement tip that won't void a single manufacturer's warranty. "If you ever have difficulty remembering what band your antenna tuner might actually be tuned to, then here's the gadget for you! It's never a good idea to key your transceiver into an unknown load, as can easily happen if you've forgotten on what band (or band segment) you last used your tuner (antenna transmission line matching network). Many tuners are not marked with regard to actual band or frequency range, so it's often difficult to see where the tuner is set just by glancing at it ... but no more!

"Take a look at **Fig. 2** and make up something similar for yourself, either out of cardboard or artist's drawing board. What's shown in **Fig. 2** is somewhat reminiscent of the old circular slide rules used by engineering students before the advent of electronic calculators and now palmtop computers. It's just a circular cardboard cutout that mounts onto another piece of square or rectangularly shaped cardboard, with a single screw through its center and a nut placed on from behind. All of your normal ham band haunts can be shown around the perimeter of the movable circle, and when you've tuned everything up correctly, move the cardboard circle to the proper position to indicate what band or band segment you're tuned to. That's it—nothing elaborate, just an always-close-at-hand reminder for those of us who need it. Don't laugh—if you don't need it now, you will!"

Reach for the stars

From Thomas Hart AD1B: Here's a tip for making it easier to operate through the RS-12 satellite. "Since becoming 'seriously' involved in hamming through the RS-12 satellite, I've been seeking out ways to make the experience even more fun. Using the satellite involves transmitting on the low end of the 15m phone band and listening on the satellite portion of the 10m band. Using only a Kenwood TS-430S, I've been able to put the transceiver's built-in split-VFO to work as the means of generating the 15m up/10m down frequency offset needed. As time went on, I thought that it might be interesting to hear my downlink signal in real time, too, so I tried using another 10m-only transceiver that I owned for that purpose. The results were disappointing, perhaps partly due to the transceiver itself not being sensitive enough, perhaps partly due to desensing caused by my own 15m transmit signal. I heard myself on the downlink, but it wasn't nearly what I had hoped for in terms of signal strength and reliability.

"My next step was to try listening for myself on RS-12's 2m downlink instead. I purchased a reasonably priced 2m to 10m converter from Hamtronics, used the 10m-only transceiver as the tunable IF for the converter, and ended up very satisfied with the overall results. The use of a sensitive receiving converter ahead of a mediocre 10m transceiver seems to be an economical answer for a better downlink monitor. Since the noise level and sensitivity are determined in the 2m converter, even a converted CB SSB transceiver may work well enough as the IF, demodulator and audio stages of a setup like this. Why not give it a try if you happen to be strapped for cash, but would still like a few bells and whistles in your satellite station?"

Cable shrinker

From Phil Salas AD5X: "In my mobile VHF ham installation, I like to use RG-8X (or RG-8M from Radio Shack™) to bring the RF from the radio at the dashboard out to the hatchback antenna mount in the rear. To then exit the vehicle, I've rigged up a short (one foot) section of RG-174/U to get through the car's hatchback gasket, and then to the outside antenna mount.

"RG-174/U 50Ω coax is the perfect size to use, being just a tenth of an inch in diameter. It easily feeds through my car's hatchback weather-stripping without spoiling the purpose behind the weather-stripping gasket. Splicing the RG-8X to the RG-174U takes place via a pair of BNC connectors and a BNC feedthrough barrel. Rigging a BNC connector for the RG-174/U can be a bit tricky, but I've had good results using a crimp-on type of BNC plug (intended for RG-58 coax) but soldering it instead to the miniature RG-174/U coax.

"Here's how I've done it: First, I tin the lip of the BNC's collar, then strip off about 1/2" of the RG-174/U's outer black jacket. I unbraid the exposed shield and fold it back along the remaining jacket. Next, I strip off all but 1/8" of the center conductor's insulation, cut the center conductor to 1/4" length, tin it, and slip the BNC center pin over the tinned end, carefully soldering it in place

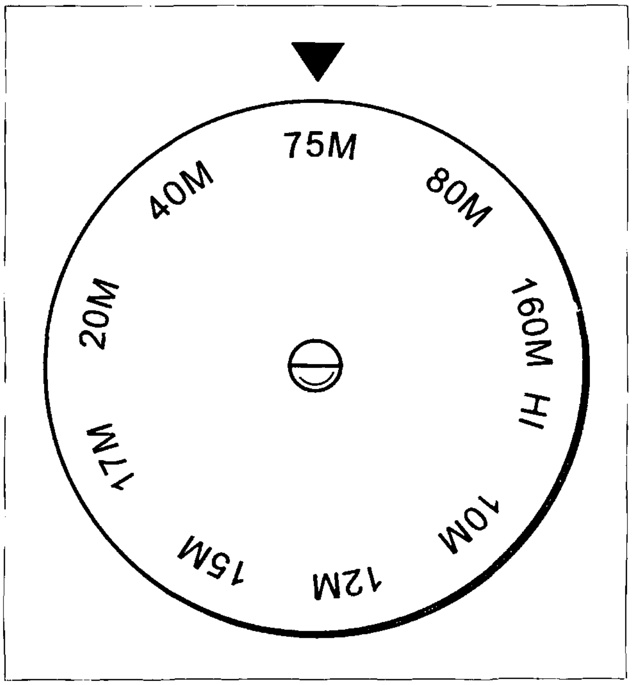


Fig. 2. W4LJD's tuner memory wheel, made of artist's board, to remind the operator of the last band or band segment for which the tuner was optimized. See text.

with minimum heat and very little additional solder. If too much solder is used, the center conductor pin may not fit back into the BNC's shell properly. If done correctly, you should now be able to insert the RG-174 finished cable and pin into the BNC's shell far enough so that the center pin is seated firmly and the tip protruding just shy of the end of the BNC shell. The final step is to solder the RG-174/U's braid to the previously tinned collar of the BNC plug assembly, again using the absolute minimum amount of heat to do the job. Allow plenty of cooling time and don't move the assembly during the cool-down period; these tiny cables can't withstand much heat, so it's best to practice on a scrap piece first.

"Last, but not least, I put a short length of heat-shrink tubing over the BNC's collar and part of the cable, and shrink it in place. The addition of the shrink tubing gives a protective, professional-looking touch to the job. Finally, connect the open end of the RG-174/U to the antenna mount that you're using, again finishing up with a short piece of heat-shrink tubing for stress resistance and weather tightness. The entire cable assembly should hold up well if reasonable care is taken to make sure that it doesn't get pinched at any time in the hatchback door-to-frame interface. It's also one that you'll be proud to show off to your ham buddies."

Battery tap tip

From Jerry Lagersbrom AAØMO: "Here's a tip to keep in mind if you need to make a high-current connection directly to your automobile's 12V battery, such as for that new mobile ham rig you just bought. Instead of splicing into the existing battery connections at or near the battery's terminals, simply use the 'spare' set of terminals that already exist on many of the current line of auto batteries. Since some automobile makers use the side-mounted terminals for their main connections, and some use the top terminal scheme, battery makers will often provide two sets of terminals on new and replacement batteries. It helps to keep down the inventory that dealers have to keep on hand. It also makes it very easy for the ham radio mobile operator who wants to tap into the battery right at the source itself, which is the recommended way of doing the job. Simply purchase the correct terminal kit (either top or side) opposite from what your car's manufacturer has chosen, and use those terminals for your mobile rig. When it comes time to sell the car, it's an easy matter to remove the radio's cabling, since you didn't have to splice into the original factory wiring for your installation. It also makes it easy to disconnect your added wiring should it become necessary to isolate a future power drain problem ... at least you can easily exonerate your ham gear from blame."

Murphy's Corollary: Any rechargeable-tool battery will run down just moments before the last of the important tasks is completed.

Many thanks to the contributors who make this column worthwhile each month. Without their continued input, I'd run down pretty quickly. They include:

Ken Guge K9KPM
1107 E. Woodrow Avenue
Lombard IL 60148-3127
[k9kpm@juno.com]

J. Frank Brumbaugh W4LJD
P.O. Box 30
c/o Defendini
Salinas PR 00751

Thomas Hart AD1B
54 Hermaine Avenue
Dedham MA 02026

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

Jerry Lagersbrom AAØMO
1301 1st Avenue
Plattsmouth NE 68048

Be sure to check out the "Ham To Ham" home page on the World Wide Web at: [http://www.rrsta.com/hth].

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73 Magazine, *and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or* 73 Magazine *for any equipment damage or malfunction resulting from information supplied in this column.*

Please send all correspondence relating to this column to Dave Miller NZ9E at the address at top. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73 Magazine*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73 Magazine*.

Number 54 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

Since the early days of AMSAT-OSCAR-6 nearly a quarter century ago, satellite chasers have devised ways to set up and operate mobile and portable stations. This has allowed them to take their favorite ham-radio pursuit on the road. High power and large directional antennas are not needed to make quality contacts through many low-earth-orbit amateur satellites, and operating a portable or mobile satellite station can be a lot of fun.

Enlightenment

My first serious satellite home station included some rather antique tube-type HF gear in conjunction with solid-state receive and transmit converters. Getting everything wired together was challenging, but operation through AMSAT-OSCAR-7's mode "B" transponder (70cm up and 2m down) was easy. I was familiar with the HF gear, and it was a simple matter to calculate the transmit and receive frequencies.

To listen on 145.950MHz with my 2m-to-10m receive converter, the HF receiver was set to 29.950MHz. Transmission on 435.150 was as simple as setting the HF transmitter to 29.150MHz. The transmit converter and the power amplifier took care of the rest. Reasonably good circularly-polarized, crossed-yagi antennas provided some great contacts, and even the occasional European DX from my south Texas station.

During a demonstration for a Houston ham group, the amplifier died due to a power problem. For about a month, I had only about 750mW of output from the 70cm transmit system. To my surprise and delight, this was sufficient to make contacts through A-O-7. Voice contacts were difficult, but the CW contacts were effortless. The effective radiated power (ERP) was calculated as 7.5W when the antenna gain and cable loss were considered. A 70cm, quarter-wave-whip, mag-mount antenna and a 10W transmitter would have done as well.

Experiments with various omnidirectional antennas were performed after the amplifier was repaired. As expected, the results were acceptable. With some extra attention to the feedline, preamplifier, and power output, superb contacts became the rule and not the exception. Similar results were obtained via AMSAT-OSCAR-8's mode "A" transponder (2m up and 10m down) using an outdoor ground-plane antenna on 2m and an indoor dipole on 10m.

Going mobile

My first attempt at mobile satellite work provided a few surprises and led to some important changes. While the results of the home station were promising, the radio configuration, power system, and antennas for the car required some modifications.

The older HF rigs were too large for the vehicle and required

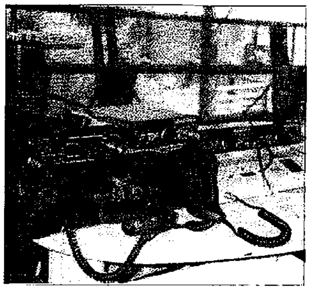


***Photo A.** A collection of multi-mode rigs covering all the satellite frequencies from 15m through 70cm.*

special power inverters to get the high-voltage DC for the tubes. The receive and transmit converters were difficult to mount, connect, and power. The car's ignition generated unexpected noise and, due to the close proximity of the transmit and receive gear and antennas, there was excessive receiver desense.

Choosing the right equipment

I decided to start over with a simple configuration only for mode "A" activity. A borrowed Kenwood TR-9000 multi-mode, 2m transceiver was used for the uplink. The antenna cable was routed away from the receive gear and the power line was connected via RG-8 coax cable directly to the car battery. The antenna was a Larsen 5/8-wave mag-mount.

A Yaesu FRG-7700 general-coverage receiver provided a usable downlink signal with some help from a home-brew MOSFET preamplifier and a cut-down CB whip antenna. Power was routed from the battery through a filter board. While some ignition noise was still present, the desense problem was gone. Several hundred contacts were made with this setup from Texas, New Mexico, Colorado, and Wyoming via A-O-8 and some of the early Soviet RS hamsats.

Park it

Did you know that you can get a ticket in Texas for inattentive driving? It's not a good idea to operate complex equipment while driving, and the state troopers will be glad to explain it to you. Don't chase satellites while in motion if you are in the driver's seat. Weak signals, changing conditions, Doppler shift and the complexity of controlling two radios simultaneously are enough without trying to keep on the road at the same time. Listening for the beginning of a pass while tuning the receiver is plenty.

Moving on

After banging up some of the radios in my mobile system, I saw that using my primary (home) rigs on the road would never be appropriate. In addition to being somewhat old, delicate, and hard to power, they are all too large and heavy. Even many of today's popular satellite radios fit into this category. I just can't see trying to mount a Yaesu FT-736R under the dash or trying to pack it into a briefcase. Even the smaller new ones like the Icom IC-821H are rather expensive to be hauling up and down the freeways.

Over the years, I have collected a number of secondhand, small, multi-mode, single-band transceivers that are employed almost exclusively for satellite work on Field Day, vacations, camping trips and mobile excursions. They all operate from 12V, can be packed easily, cost between $80 and $250 each, and are old enough to repair without a microscope and a super-fine-point soldering iron. A few scratches and dents won't bother me as long as they provide good service.

For the 15m uplink to RS-12, I use an NCG 15m SSB/CW transceiver. It was $80 at a local

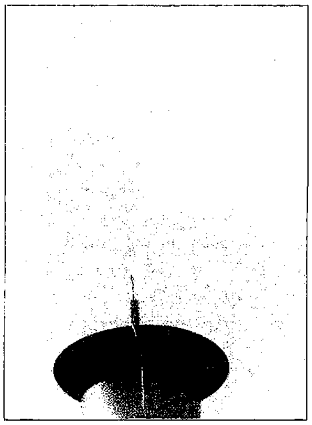


***Photo B.** A modified "CB" mag-mount saw portable use as an RS-12 uplink antenna while perched on a chimney pipe.*

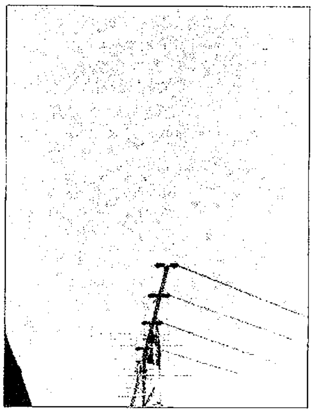


***Photo C.** A CushCraft Ringo Ranger easily mounts above the TV antenna for hamsat operation.*

swapfest, is very simple, puts out about 15W, is a bit large at 9 x 9 x 2.5 inches high, but has a nice three-digit LED frequency display. It is a bit rare, but there have been a few similar 15m solid-state monobanders produced by other companies over the years. With a simple dipole antenna, most of my RS-12 contacts have been made with this radio while away from home.

A Uniden HR2510 10m all-mode transceiver has provided good service for mode "A" downlink work. While there have been several modifications to boost its power output, that has been unnecessary for my receive requirements. Its sensitivity is good. While it lacks selectivity, congestion on the satellites is usually not a factor, and this radio does its job well. The Radio Shack HTX-100 and Uniden HR2600 are almost identical, with the exception of fewer modes in the Radio Shack transceiver and a few more features in the HR2600 version. Prices on these radios range from $100 to $180, depending on the condition.

My Yaesu FT-480R, multi-mode, 2m transceiver has been the central unit of my portable and mobile configuration for a number of years. It was purchased from a local ham for $250 and does a great job for both mode "A" and "J" (2m up and 70cm down) uplinking with 10W output, and mode "B" receive, sometimes with a preamp. The central microprocessor went out soon after purchase, but Yaesu was very helpful with a reasonably-priced replacement. There are excellent multi-mode 2m rigs available from all the major ham manufacturers. Price and availability are the determining factors.

Finishing out my monobander collection is the Yaesu FT-780R for multi-mode 70cm mode "B" uplink activity and mode "J" reception. It was originally purchased in Panama. After a few years, it found its way to my shack in Houston after an exchange of $225. The 70cm satellite band is from 435 to 438MHz. The FT-780R operates between 430 and 440MHz, thus covering my needs. For those requiring a radio that will work terrestrial 440 repeaters, this rig is not appropriate. There are other transceivers that tune 420-450 or 430-450MHz.

The only new radio in my collection of mobile/portable satellite rigs is an Alinco DJ580T dual-band (2m and 70cm) HT. It has provided many excellent FM contacts with *Mir*, the Shuttle, and AMRAD-OSCAR-27 using the large battery pack and 15-inch dual-band whip antenna.

Antennas and amplifiers

While ground planes and other omnidirectional antennas have worked well for the LEO hamsats from the car, I have tried a few yagis, quads, and helix antennas while out fishing or camping. The extra gain has always helped, but without rotators, I feel a bit silly running back and forth to the antenna array every few minutes to re-aim. Experimenting in the back yard before an outing to a remote location usually provides

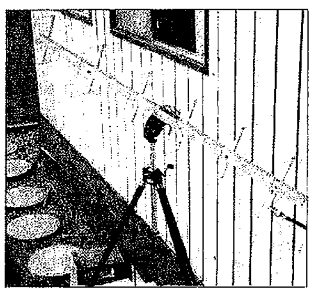


***Photo D.** An old camera tripod provided support for a seven-element 70cm quad during a fishing trip.*

an opportunity to determine the best configuration beforehand.

Occasionally I have needed an amplifier to get a good signal up to a target satellite. If the power is available and the transmit signal doesn't cause desense in the receiver, an amplifier has made the difference between a few difficult QSOs and many easy contacts, but there's a catch. The key to good satellite operation is to focus on the receive system before increasing the output power. There are already too many stations on the amateur satellites that overload the transponders just because they have inadequate reception and keep raising their uplink signal until they can hear themselves. Good preamps and downlink antennas come first.

What's next?

If you haven't undertaken mobile or portable hamsat chasing, give it a try. It's not easy, but the results are certainly satisfying. Check out the used gear at the conventions and swap meets. It's best to keep the big rigs at home and the small inexpensive ones on the road.

There are some out-of-production HTs that do CW and SSB, including the AEA DX Handy for 10m and the Santec LS-202A for 2m. There are also a number of new CW/SSB HTs made in Japan that are not marketed in the United States and cover the bands from 40m up through 70cm. They occasionally show up for sale on the used market and might provide even more fun for satellite backpacking and low-power (QRP) satellite work. 73

NEVER SAY DIE

Continued from page 45

"donation" buying some influence. And, indeed, I found that the system worked as I expected. Donors usually get through to the man, non-donors don't. And that's bribery.

So we're reading about the High Crimes of the Clinton White House and both of the political parties, plus the time that congressmen have to spend building their re-election campaign funds.

When the money is a bit short a senator can threaten an industry with a hearing. Since almost (?) every industry is crooked, that loosens the purse strings in a hurry. I remember when Senator Dodd of Connecticut was charged with that by a Senate Committee.

Fortunately we have the fox guarding the hen house, so we're not seeing any indictments or impeachment proceedings, despite the patent illegality of the whole campaign funding process.

The solution? The only one I can think of is my Never Reelect Anyone (NRA) approach. That would at least make reelection campaigns unnecessary, since all incumbents would be eliminated in the primaries. It would help, but it wouldn't totally discourage the swarms of lobbyists waving suitcases full of cash at our representatives.

I've also proposed that state legislatures pass laws making it illegal for any congressman to speak or vote on any bill which might affect the business of any donor. That might help dry up bribery. Further, to initiate such an actions I've proposed that every ham club select a club member and run the member for the state legislature. We need to start having some political clout anyway.

Boiled Silver

I see where Bob Beck is recommending that you silver merchants use less salt to make colloidal silver by making it while boiling your distilled water. He says this makes a finer grade of colloid which will keep longer and act faster. I'm building quite a file on colloidal silver, but I'm not sure how much of it is fact and how much exaggeration. In the meantime, I've got Dr. Douglass of *Second Opinion* saying not to drink the stuff, while on the other hand there's a ton of testimonials telling about the wonders of drinking it.

Well, I don't think you can go far wrong if you use it to prevent salmonella on chicken and

Continued on page 77

HOMING IN

Number 57 on your Feedback card

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
[Homingin@aol.com]
[http://members.aol.com/homingin/]

Build the NorthScope

Sometimes hidden transmitter hunting (T-hunting) is easy. I get sharp, unambiguous bearings, drive directly to the hidden T on good streets through light traffic, and my passengers ask, "What's so hard about this?"

Or was I just daydreaming? Actually, it seems as if every time I take ride-alongs to demonstrate the fun of radio direction finding (RDF) contests, the hunt is extra difficult and I don't do as well as I would like. Of course, it wouldn't be fair to blame the passengers for upsetting my concentration. The fact is that there are wide variations in difficulty of T-hunts due to variations in signal level, polarization, terrain, and the surroundings of both the hidden T and the hunters. I'm always seeking out new ways to get the best bearings in the worst circumstances.

Most two-meter T-hunters in southern California use a yagi or quad of three to six elements on a mast extending vertically from the vehicle window or roof hole. They depend on the radio's S-meter to tell the direction of strongest signal as they rotate the mast by hand. An RF attenuator keeps the meter on scale when closing in. In urban areas where signals are constantly reflected from hills and buildings (multipath), the beam's sharp forward lobe can pick out each direct and reflected signal component. That's a major advantage of the beam method over a Doppler or dual-switched-dipole setup.

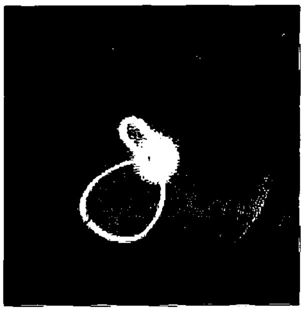


Photo A. A local repeater produces this pattern on the mobile quad and NorthScope. The main forward lobe at 220 degrees true is the direct signal. The second lobe at 320 degrees is reflected signal from nearby foothills.

The down side is that interpreting your beam's indications can be tricky and time consuming, slowing you down when speed is of the essence. Sometimes multipath, airplane flutter, and path blockage make the S-meter reading fluctuate constantly as you roll along. Getting an accurate bearing on the direct signal while ruling out reflected signal peaks under these circumstances is not an exact science. A few experienced T-hunters have improved their performance with polar-plot bearing displays of signal strength versus direction on a cathode-ray tube (CRT) or computer.

CRT bearing readouts featured in past "Homing In" columns include those of KK6CU (October and November 1992), NØMKJ (March 1994), and AB6OS/KA6SOX (November 1993). The screen shows signal strength versus direction from multiple sweeps of the antenna so the operator can "eyeball average" fluctuations resulting from motion. It is much easier to discern the most likely direct signal direction in a multipath environment with a polar display than it is with just an S-meter.

North-up is better

All of the above polar displays show signal directions relative to the vehicle's heading. That's fine when you're driving in a straight path and you know exactly which way you're going. But what about T-hunts that take you on winding roads in new housing developments or along desert washes in the middle of nowhere? How can you interpret the display accurately when it rotates as the vehicle turns?

Last month's "Homing In" showed how a fluxgate compass sensor on your mobile beam detects the mast's orientation with respect to true north. Why not combine the fluxgate sensor and CRT readout to produce a polar display of signal strength that is always relative to north, no matter which way you turn? In aviation terms, this is called a "north-up" display. I call mine the NorthScope.

For good "eyeball averaging," the CRT must display several rotations or sweeps of the RDF antenna at a time. An ordinary oscilloscope won't do—you need a storage-type oscilloscope or a high-persistence CRT like those in radar sets of the pre-computer era. The NorthScope trace of **Photo A** is typical for a strong signal with a small amount of multipath. The higher the beam's gain, the sharper and narrower the major lobe will be. Note that this pattern is consistent for every rotation of the antenna because the vehicle and source are stationary and there are no moving objects such as aircraft in the path.

The NorthScope is at its best in a difficult RF environment such as in **Photo B**. The large repeatable lobe identifies the most likely direct bearing to the T. Reflections and noise in other directions show up as a jumble of non-correlated traces after several rotations of the mast. If there are two or more keyed-down transmitters in different directions on the frequency simultaneously, the NorthScope can resolve bearings for each of them. Try that with a Doppler!

Sometimes the signal level flutters, making it hard to find a peak on the S-meter. Worse yet, imagine the S-meter bounce if the signal switches on and off every second or so. (It's legal on some hunts!) Under these conditions, turn the antenna slowly several times, find the peak on the polar display, then read the direction.

A CRT readout need not be a budget-breaker. Used storage scopes show up regularly at electronics surplus sales and swap meets. They aren't cheap, but if you're an experimenter, you will find other uses for one around the shack. Medical monitors such as the Tektronix Model 603 include waveform storage and are available on the surplus market at lower prices. Look for scopes and monitors that accept two analog inputs and have an X-Y mode, plus gain and position controls for each channel.

Laboratory scopes and medical monitors are designed to operate from household outlets. You will need a DC-to-AC step-up converter to adapt them to mobile use. PowerVerters™ by TrippLite are suitable and available in several wattage ratings. Be advised that the current drain of a storage scope or monitor can be substantial; a heavy-duty car battery is a good idea.

A simple interface

To connect the scope to the sin/cos fluxgate outputs (described last month) and draw a polar plot as the mast goes around, we need a circuit that varies the sine and cosine amplitudes in proportion to the incoming signal level. The analog multiplier, a little-known function block, is perfect for this task. Not to be confused with the more common analog multiplexer (which switches signals), the analog multiplier produces an output signal that is the exact product of two input signals. For instance, if one input is +2 volts and the other is +3 volts, the multiplier output is +6 volts.

Photo B. This distant simplex signal is on the other side of a hill, so it has lots of multipath and airplane flutter. By viewing several overlaid sweeps with the NorthScope, it is clear that the most likely bearing is 235 degrees.

A four-quadrant multiplier takes into account the polarity of input signals. If A input is -2 volts and B input is +2 volts, output is -4 volts. Put in -1.5 volts and -2.0 volts to get +3.0 volts, and so forth. Typically, the product voltage is internally divided by a factor of 10. This makes sense when you consider that the result of 5 volts times 5 volts is too great for a circuit powered by a 15-volt source if the output is not scaled down.

Analog multiplier integrated circuits are inexpensive and ideal for modulators, wattmeters, voltage-controlled amplifiers, and automatic gain control stages. The major suppliers of these ICs are Analog Devices, Harris Semiconductors, and Motorola Semiconductors. Sin/cos signals swing positive and negative, while S-meter signals are positive. Therefore, the multiplier must operate in two of the four quadrants.

I chose the Motorola MC1495, available from nationwide distributors such as Newark Electronics. The dual-inline package (P suffix) is easiest for home builders to use, but it may be harder to find than the surface-mount (D suffix) package.

Fig. 1 is the fluxgate-to-monitor interface circuit schematic. There are separate analog multiplier ICs and operational amplifiers for the X and Y axes. All parts except the multipliers are available at local parts stores. They fit onto a few square inches of perforated board space (**Photo C**). Construction is simple, even without an etched circuit board. No ground plane is needed, but be sure to put the supply bypass capacitors close to the ICs. Mount S1 and R1 in convenient locations for adjustment during T-hunts.

Inputs of the multiplier ICs are differential amplifier stages. That's ideal for this application because the sin/cos outputs from the fluxgate compass vary positive and negative with respect to a +4.2-volt analog reference. By connecting multiplier inverting input pins to the analog reference, that relationship is preserved through the interface circuit and there is no need for a regulated negative voltage supply. U3A and U3B convert the differential outputs of the multiplier ICs to single-ended.

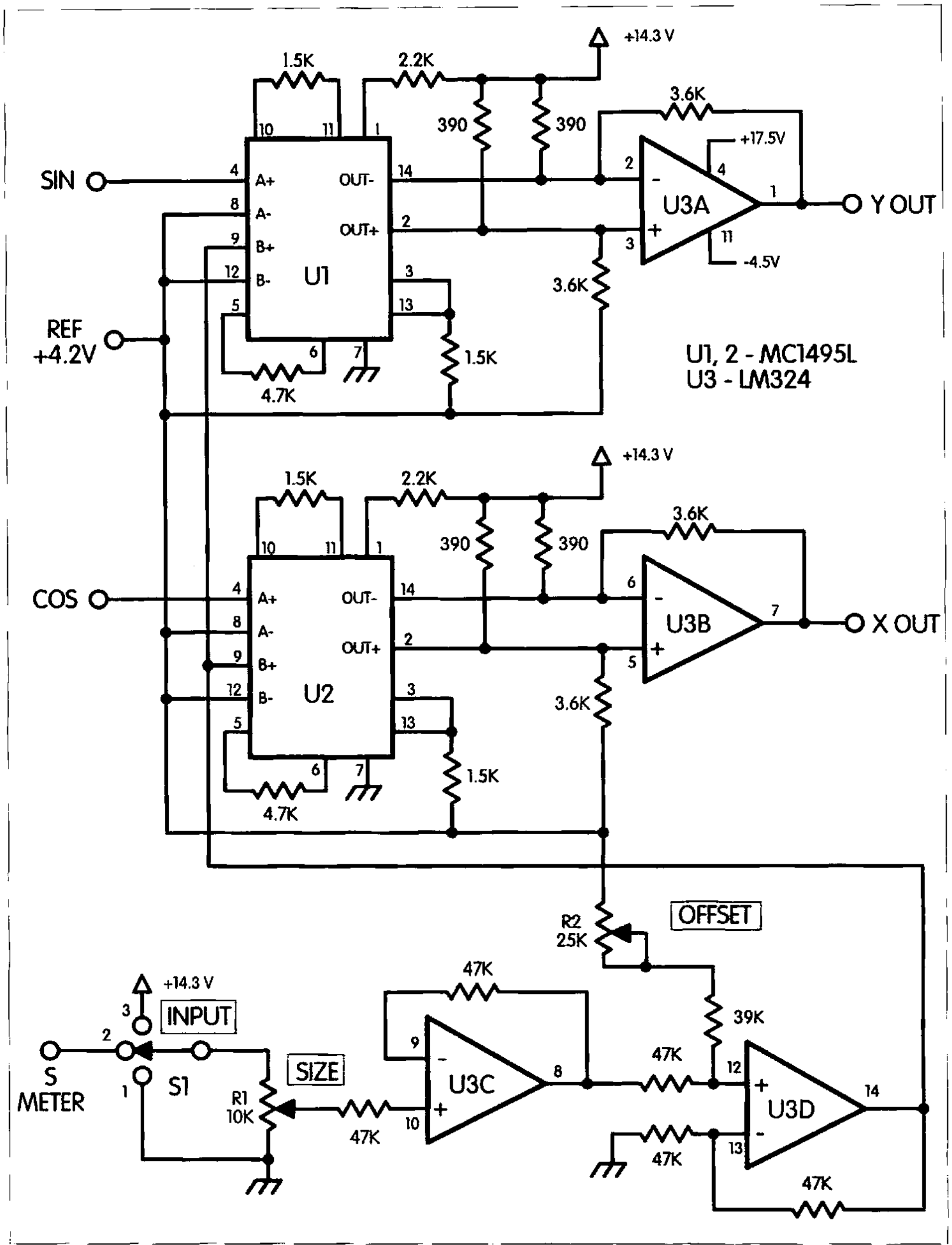


Fig. 1. Schematic of the interface circuit that combines fluxgate compass and S-meter signals to drive a north-up CRT display. Resistors are in ohms and capacitances are in microfarads unless otherwise noted.

My receiver's S-meter tapoff circuit is described in Chapter 5 of the book *TRANSMITTER HUNTING—Radio Direction Finding Simplified* (available from *73*'s Radio Bookshop). It includes an operational amplifier to drive an analog panel meter atop the dashboard. The op-amp output in that circuit goes from zero to +10 volts full scale and connects to the point marked S-METER in **Fig. 1**. U3A is a voltage follower stage with unity gain; U3B adds 4.2 volts to the S-meter voltage as required by the differential analog multiplier inputs.

To ensure sufficient headroom in the multiplier and avoid waveform clipping under all input conditions, use care in choosing supply voltages for the interface circuit. The positive supply to the MC1495 ICs should be regulated. Supplies for the LM324 quad op-amp can be unregulated. The LM324 positive supply (pin 4) range is +15.8 to +20 volts; negative supply (pin 11) can be -1.5 to -12 volts. Look for places to tap off these supply voltages within your monitor.

Tune-up is easy

A few simple alignment steps are required to set up the NorthScope for the first time. Connect all the assemblies and install the fluxgate sensor on your antenna mast. Set the focus control on your monitor for a minimum-size spot. Keep the

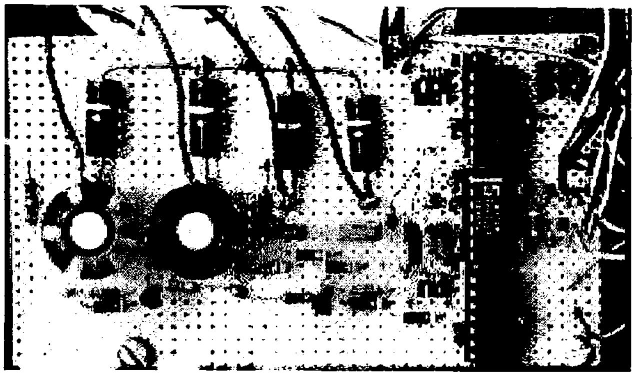


Photo C. The three ICs and associated resistors on the right side of this perforated board are the fluxgate/S-meter interface components. The rest of the board holds CRT deflection amplifiers for the home-built monitor.

brightness control as low as practical to avoid burning the phosphor screen of the scope. X and Y channel sensitivity settings should be about one volt per division, depending on your screen size.

Turn SIZE control R1 on the interface to zero. Set input switch S1 to SPOT (position1). Set the X and Y position controls on your scope to center the spot on the screen. Turn the mast and sensor around 360 degrees; the spot should not move. If it does, adjust OFFSET control R2 until the spot does not move as the mast turns. Now re-center the spot, if necessary, with the position controls.

Set S1 to CIRCLE (position 3). Adjust the SIZE control to move the spot about an inch toward the edge of the screen. Rotate the mast/sensor and adjust the X and Y gain controls and the two screwdriver-adjusted potentiometers on the left side of the fluxgate compass display for a perfect circular pattern around the center spot position. The E-W and N-S pots on the fluxgate equalize the left-right and top-bottom voltage swings such that positive excursions equal negative excursions for each axis. This makes the circle trace exactly over the spot (see **Fig. 2**). If the circle is elliptical instead of round, adjust the X and Y channel gains as appropriate.

Set S1 to TRACE (position 2). With your receiver tuned to an active repeater and enough RF attenuation that the S-meter does not peg, swing the beam around and adjust the SIZE control for a trace similar to **Photo A**. There is plenty of gain in the S-meter channel, so you can get a full-size trace even if the incoming signal only moves the S-meter to quarter-scale.

Notice that the reflection lobe in **Photo A** is quite sharp but the major lobe is broad at the outside. This is caused by nonlinearity in my receiver's S-meter circuits. Normally this is not a problem, but I can get a sharper lobe if needed by adding RF attenuation to the receiver and turning up the SIZE control to compensate. It should also be possible to add nonlinear devices such as diodes to the feedback path of U1A to make that stage an antilog amplifier; I have not tried this yet.

While the north-up display could be used with a motorized mast like the displays of KK6CU and others, I prefer turning the mast by hand. Not only does it simplify the project (no slip rings for the coax and sin/cos signals), it also makes it easier to find the exact direction of signal peaks as displayed on the scope. I can rock the beam back and forth until I'm satisfied that I have found the optimum bearing. This is particularly helpful when there is airplane flutter or rapid amplitude changes due to keying or high modulation levels.

I have enjoyed building several oscilloscopes over the years so I decided to make my own monitor/display for the NorthScope. By modifying a commonly available "boat anchor" scope and raiding the junk box, the cost was under $100. The monitor draws about as much as a typical mobile receiver, so I don't worry about draining the car battery. Next month's "Homing In" will have all the monitor details and some thoughts on computerizing the NorthScope. Meanwhile, keep sending your T-hunting news and column suggestions via E-mail or my post office box. Thank you!

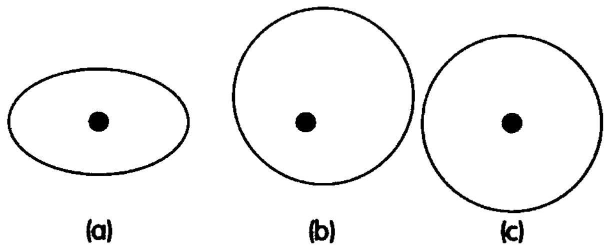


Fig. 2. At (a), unequal horizontal and vertical gain. At (b), offset due to misadjusted E-W and N-S controls. At (c), a perfect circle in proper position.

ASK KABOOM

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

It's heeeere!

As I sit down to write this column describing the arrival of the first home VCR and the impact it had on our world (which goes far beyond television), I realize I have a little celebration of my own to consider: This is my 100th column. Can you believe it? It's been more than eight years now! I feel privileged to have been able to serve you all these years, and I hope it will continue as time and technology march on.

For the past few months, we've been exploring video and video recording. Last time, we were examining the obstacles that kept this technology out of the home for so long. Let's look at the first of the two biggies and how it was solved. (Hint: They both involve radio-related techniques.)

Hurry up and slow down

The biggest obstacle to the home VCR was the rate of tape consumption. Even at the seven and a half inches per second (IPS) of the EIAJ standard, too much expensive tape went through the machine per hour. And I do mean expensive: Videotape, which had to be made to very precise tolerances, required a higher level of manufacturing precision than was generally available for consumer products at the time, so costs were high.

The audio tape world had clearly shown that people hated threading tapes and would avoid buying recorders if they had to do it; home audio recording only took off when the cassette became widely available, even though much superior-sounding reel-to-reel recorders had been available at reasonable prices for many years. So, any successful home video recorder had to use a cassette. Also, it was anticipated early on that home users would want to time-shift recordings for later viewing, and that meant at least an hour of recording on a tape, preferably much more. The size of the cassette would be daunting to most people.

The race was on to reduce tape usage. The answer proved to be fairly straightforward, although making it work in color was not. Here's a little background that'll help with understanding how they did it:

In any tape recorder, signals are recorded as regions of magnetism, like little bar magnets, next to each other on the tape as it goes by. (OK, there are other ways, such as through the tape, but they are problematic and never caught on.) The narrower the magnets, the more you can fit into a given tape length. As we discussed before, though, there are practical limits as to how narrow you can make them before you can't read them anymore. The solution to recording the large quantities of information required for video was to use rapidly rotating heads that traced out long, thin tracks diagonally. A servo mechanism would then position the heads during playback so they'd scan the tracks and not the space between them.

Space? What space? Well, in theory, you didn't need any, because each head would hit only its own track. In practice, though, it didn't really work out that way. Due to mechanical tolerances, notably wow and flutter in the tape drive, some of the signal from adjacent head sweeps would get picked up by the head as the tape's precise position wandered a little bit. That resulted in interference and unacceptable playback, so the tape speed was increased to make some space between each track. They called that the "guard band." It worked, but it upped the tape speed considerably, since a significant percentage of the tape wound up being wasted to allow for all that unrecorded space. In fact, the guard band was a primary cause of high tape consumption—but how to get rid of it?

History to the rescue

Developers of audio recorders had long known that head alignment was crucial for maximizing the amount of information—high frequency response in the audio world—a tape could hold. Specifically, the head gap, which both creates and reads the bar magnets, should be at a right angle to the direction of tape travel. (That setting is called the "azimuth" adjustment.) If you draw two parallel vertical lines close to each other to represent the head gap, you can see why. As the tape moves past the lines, it will take a linear distance equivalent to the width of the gap for one magnet to move out of the way completely, so another one can be written.

Now, draw some vertical magnets, and try tilting the head gap in relation to them. What happens? The *effective* gap width, which is from the left to the right of the entire gap, is much bigger, because at one end the gap sticks way to the right, and at the other, way to the left. Much of the energy the magnets would create as they move by is lost within one gap-width when the magnets are not very wide, because more than one magnet can fit in at a time. The result is seriously reduced high-frequency response, just as if the gap were much bigger than it really is. In an audio recorder, that's bad.

Crooked isn't always wrong

As you may recall, I mentioned that video is recorded using FM. As hams, we know something about that mode. The important thing here is the capture effect: A stronger signal can completely obliterate a weaker one, as long as they're more than a few dB apart. The key to Sony's Betamax™, which ushered in the low-tape-speed home VCR, depended on that effect. They eliminated the guard band by slowing the tape down so much that adjacent tracks not only had no space between them, they actually cut into each other—the result being tracks narrower than the heads that created them!

"But what about the interference?" I hear you say. Yes, it would be massive if that's all they did. With tracks thinner than the heads, each head sweep would pick up signals from three sources—the desired track, and the adjacent ones on each side. What a mess!

The real cleverness of their scheme lay in deliberate misalignment of the head azimuth. By tilting one video head about 17 degrees left and the other the same amount right, they created more than 30 degrees of misalignment between tracks. So what?

Well, let's call one head the A head and the other the B head. When the A head is reading its track, it's picking up its intended signal, along with signals from the adjacent B tracks, but those tracks are seriously out of azimuth alignment with the A head (which is aligned opposite to the one that created them), so they will be much weaker. Combined with the FM capture effect, the adjacent tracks' signals simply disappear! And that, gentle readers, was the key to the home video recorder, the grail sought for twenty years. (Well, almost. There's still that pesky color problem to deal with.)

The first Betamax recorded one hour on a cassette. While we might laugh at that today, it was, at the time of its introduction, the highest recorded information density ever achieved on magnetic tape, bar none. Not even the military had anything which could store that much material on so little tape. It was also the most complex consumer product ever made; it was so far beyond the radios and TVs of the time that there was no comparison. People were eagerly buying tape recorders more complex than their *cars*.

The implications of that feat of information storage were little recognized at the time, but the availability of consumer-priced, megahertz-rate recording ushered in much of what we have today. I'm not suggesting that gigabyte-sized hard drives work the same way (they don't), but the VCR created a consumer demand for the manipulation and recording of large amounts of information. A six-transistor radio just wasn't an exciting product anymore. Suddenly, that old audio cassette

Number 61 on your Feedback card

The Digital Port

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703
[jheller@sierra.net]

All those TNC commands ... and how we solved the "too many retries" dilemma

This column is about solving problems. After all, isn't it great when you find a solution? If anybody needs solutions, it is this digitally-obsessed ham, so as quickly as I get them, I pass them on. Hopefully, they are of value to my readers.

This month's conundrum concerns a perfectly good direct packet connection that quit working a few months ago—and it was from *my* shack to the local PBBS just across town. That's serious, especially when I am writing this column. If I am looked upon to answer questions, I'd better answer my own.

To begin, there were several failures. You may recall from last month's column how my computer had ceased to converse with the terminal node controller (TNC). That was a problem of the first order and I assumed, once it was in working order, this packet connection would start cooperating.

General Rule #1: Assumptions generally make my life uncomfortable.

So ... yes, the problem is located. Contact with the PBBS has been reestablished. I'm easy to please—just make my radio work. When I test problems like this, I use as much logic as possible, but logic was playing a few wild cards ... again.

Part of the dilemma with logic is that we like to bypass the steps we "already know the answers to." Last month, after installing XPWare, it appeared that the PK232-MBX was in business on all modes, except for the local packet connection. Difficulty in making and maintaining solid connections has given me fits in this corner of the valley for as many years as I have worked packet.

There are definite signs of multipath. When a signal is transmitted, it bounces around the valley and wreaks havoc at this receiving antenna; too many signals out of phase and therefore unreadable. This was solved a few years back when Martin N7NPB installed the CCBBS just a couple miles away, but still there is a sizable hill along the path. Martin has gone to great lengths to defeat the multipath monster, but at times, he has resorted to transferring files to and from the next node via landline.

When my latest problem arose, it seemed normal to assume something had changed in the geological structure of the valley and the multipath demon had returned; after all, construction never ceases. Just about every test proved this (when I know the answer, it is easy to plug in the correct circumstances). I was so comfortable with the diagnosis that Martin was ready to invest in more equipment to fix the problem. That is the way with hams—the good guys feel there is nothing too good nor too expensive if it will make life better for a fellow ham.

Deceptive screen messages

Some of the strange symptoms of the disease were manifested when KB7NO sent a connect request to CCBBS; the perfectly readable response would show up on my screen and seemingly indicate the connection was made. However, this wasn't so. I had Martin watch from his end and he could see the connect request frame come across his screen, which would trigger his system to send out the welcoming frames that included the instruction for me to tell CCBBS what I wanted (read mail, bulletins, etc.).

The missing ingredient was that the "connect" LED was not lit, on the front of my PK232 panel. This was followed by a lot of unacknowledged signals transmitted back and forth, until my screen would display the message "retry count exceeded—Disconnected." Once in a great while a fragile connection would be made—always immediately after I had changed something (never the same thing).

So ... this led me to think there is something valuable to put into this month's discussion while I tell about the angst I was suffering and the steps, though logical, that wound very slowly around to a realization of the true nature of the problem. Incidentally, I took a quick look into the on-line dictionary for angst. The words anxiety and depression certainly are descriptive of the mood that prevailed for a few days.

Changing the TNC commands from default

One of the areas I experimented with was the commands that you can define in your TNC, and this is something you need to be at least cognizant of. There are approximately 100 definable commands in most TNCs. For instance, one that is required before you can make a packet connection is MYcall. It simply states your callsign so the station you are connecting to can identify you.

Modern software installs your call automatically when you are setting up the program, so you don't want to attempt to bypass this part of the setup. In primitive programs, you are instructed to go to the *cmd*> prompt and type *MY [space] [your callsign]*. MY is short for MYcall. It is okay to type the command in its entirety, but nearly all commands have an abbreviation.

You will find that the defaults are usually set in the memory of the TNC and you will be able to operate just fine without changing much other than entering your call. Some of the commands affect what you see on the monitor; some alter the packet to be sent; others are for automatic messages you may send; and there are those for mailbox functions.

The ones I felt were most worth tweaking were the ones having to do with timing the sent packets, in respect to the incoming packets. See **Chart 1** for a list of the commands I worked with the most. You will notice that all these function to cause a "wait" interval to avoid having two signals collide.

In **Chart 2** you will see other commands I changed for various reasons described. It's good to know as much as you can about these commands. They are not all the same with all brands of TNC. However, they are described in the operator's manual for each TNC.

There is considerable latitude in the settings, and every now and then, it appeared that there was progress—that I must have repaired a nerve in the system—and the two systems would magically connect. However, the connection was poor and seldom did any subsequent commands perform their functions.

The impression that I was doing battle with multipath signals was further solidified as I finally

---

recorder didn't seem like much, either.

Even more than that, the huge success of the VCR ushered in the era of cheap high-precision manufacturing that has brought us the home computer, CD players, camcorders, pocket-sized dual-band HTs, you name it. VCRs required all kinds of specialized ICs, which drove the chip makers to new levels of expertise. The machines also required mass production of extremely precise mechanical assemblies, something never before done on such a scale. In the mid-1970s, it cost more—much more—to put a pair of new heads on a black-and-white reel-to-reel video recorder than it does to buy an entire new color VCR today. Whereas the process used to have to be done by hand, under a microscope, we now have entire head drums, with heads mounted, completely made by machine in factories that input raw materials and output fully aligned, ready-to-use assemblies with tolerances in the micron range. Yes, the VCR was a tremendous instrument for technological progress, even if people do use it mostly for catching up on mindless sitcoms.

Next time, we'll explore that other big obstacle: the recording of color. Until then, 73 de KB1UM.

COMMAND	FUNCTION
TXdelay n	Specifies the wait in 10ms intervals that the TNC is to wait after keying up the transmitter before sending data.
AXhang n	Another wait parameter that specifies the time in 100ms intervals that the transmitter will wait after the repeater keys up before sending data.
AXdelay n	Specifies the wait time in 10ms intervals to perform the same function and in addition to AXhang.
DWait n	Specifies the time in 10ms intervals that the TNC will wait after the last heard signal on a channel before keying up.
RESptime n	Specifies the time in 100ms intervals that the receiving TNC will wait before sending an acknowledgment of a received packet.
FRack n	Specifies the time in seconds the transmitter will wait for acknowledgment after sending a packet before sending the frame (packet) again.

Chart 1. *These commands are specifically used to help avoid collisions between packets by preventing simultaneous sending and receiving between stations on the same frequency.*

found a station connected to CCBBS whose transmissions I could copy on my monitor. Most other stations were from another side of the hills and their signals could not be copied on my monitor, only those signals from CCBBS.

Digipeat looks like the answer

I entered a connect path to CCBBS via the other station and got an instant connection. Some of this was pure luck—this TNC user had the digipeat option "on," plus his connection continued long enough to get my desired result. Elated, I sent Martin the news.

I started making plans to set up a digipeater in another part of the valley. [Short explanation: Digipeating is a handy function of the TNC. It allows stations to connect through one another and each will pass along (repeat) digital messages that would otherwise be difficult or impossible due to distance and/or terrain.]

In preparation to setting up a digipeater, I dug out an MFJ-1274 and started getting cables ready. Martin, in the meantime, was making his own plans, on a grander scale, to put up a node on a nearby peak. I felt it might be a good idea to first try the 1274 in the shack to be sure it still worked.

After a few false starts, I got the 1274 in place of the PK232 and, after a little configuring, got the screen to speak a language I understand. I tried a connect to CCBBS just to be sure everything responded and, lo and behold, the connection worked—first try!

I spent at least ten minutes connected, to see that this wasn't just another coincidence, and sent Martin a personal message. Then I disconnected and connected and read a few bulletins. Definitely, the source of the problem was found. This should prove, until next time, though many things are improbable, nothing is impossible.

The next thing was to contact the new owners of the AEA line, Timewave. I checked their Web page and did not see a phone number, so I sent them E-mail describing my dilemma. At this writing, they have not had time to respond. By the time this is published, the actual problem will have been resolved.

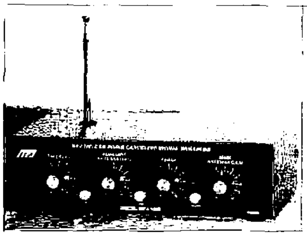
If you have questions or comments about this column, E-mail me at [jheller@sierra.net] and/or CompuServe [72130.1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line [KB7NO@N7NPB.#NONEV.NV.USA.NOAM]. For now, 73.

COMMAND	FUNCTION
PASSAll	This will turn error correction on or off. Therefore, if there are packets being received, they can be viewed.
FUlldup	Normally off, but with it on, I was able to view all the commands as they were being sent. However, it encourages collisions.
WHYNOT	This shows up in some AEA packages and is meant as a diagnostic tool. My screen filled with a form of "weak signal" messages.
PErsist	This is also AEA-specific. This is meant for use with multiple connects to avoid collisions by monitoring carrier detection (DCD).

Chart 2. *These commands were experimented with to explore the possibilities offered. Each manufacturer/programmer offers ideas that are worth exploring when the solution becomes difficult.*

Number 63 on your Feedback card

New Products



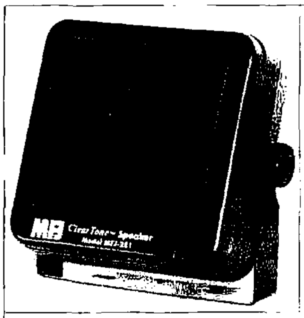
Wipe Out!

Wipe out that interference and noise before it gets into your receiver, that is. When you plug your station antenna into the MFJ-1026, your antenna system turns into a directional receiving array! You can place a null up to 60dB deep on any type of noise and interference arriving from any direction and wave angle. Lightning crashes from distant thunderstorms, severe power line noise from arcing transformers and insulators, lamp dimmers, touch-controlled lamps, electric drills, industrial processes, TV birdies and more can be eliminated with the MFJ-1026 Deluxe Noise Canceling Active Antenna.

Is a strong local ham overloading your sensitive receiver? Cast a deep null on him and literally take him out—you won't even know he's there. Null out your local AM broadcast station, and underneath you might find a far-away station in an exotic place you've never heard of!

The MFJ-1026 simply plugs in between your transmitting antenna and transceiver. To null, adjust amplitude and phase controls for minimum S-meter reading or lowest noise. To peak, push reverse button. Use the built-in active antenna or an external one; it's better than a phased antenna—you can electrically "rotate the array" while the antennas remain stationary.

The MFJ-1026 is priced at $139.95, and has a little brother without the built-in active antenna; the MFJ-1025 is only $119.95. For your nearest dealer or to order, call (800) 647-1800; FAX (601) 323-6551; or write MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.

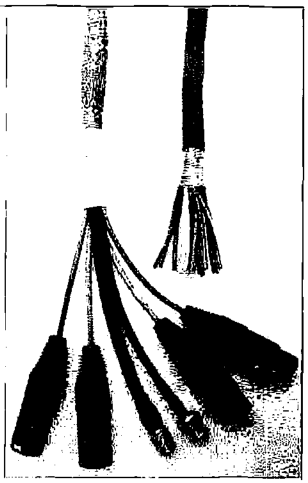


Just Like Magic

MFJ proudly announces the MFJ-281 ClearTone™ Communications Speaker for SSB, FM, AM, and CW. Plug it in and MFJ promises speech fidelity that you never knew existed. The MFJ-281 will restore the smooth sound of sine waves that CW naturally generates and make it far easier to copy. Small built-in speakers just can't deliver this kind of tonal quality. The ClearTone was carefully designed to improve the intelligibility of speech in the frequency range of 600 to 4,000Hz while reducing undesirable noise, static and hum.

The MFJ-281 is less than four inches square and will handle 8W, 8Ω. It comes with a six-foot cord and 3.5mm mono plug, and a versatile swivel mounting bracket lets you direct the sound where you want it—and all this for only $9.95! And, of course, it's covered by the MFJ *NO MATTER WHAT* one-year unconditional warranty. For your nearest dealer or to order, call (800) 647-1800; FAX (610) 323-6551; or write to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.

New Camera Cables from Nemal



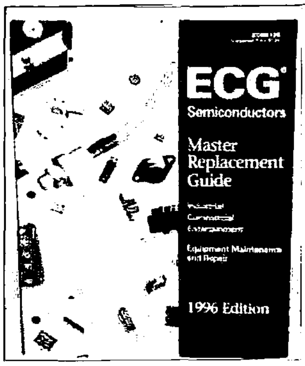
Nemal Electronics International has introduced a new line of multicore camera cables for use with Sony, JVC, Toshiba, and other equipment. The cables feature precision coaxial members, various control wires, and a flexible outer jacket, which offers protection from temperature extremes, abrasion, oil, gas and ozone.

Nemal has also introduced a new remote control composite cable for use with Sony paintbox remotes, making it easier to use the Sony remotes in field applications, and providing all the required interconnections under a single flexible jacket—Nemal's high-performance flex jacket. Standard terminations include XLR for audio, BNC for video, and a 10-pin plug for the remote cable.

For more information, contact Nemal Electronics at (305) 899-0900; FAX (305) 895-8178 or E-mail: [info@nemal.com].

It's a Catalog! It's a Newsletter!

No—it's *Electronic Experimenter's Journal*, published by Debco Electronics, Inc. More than just a tabloid catalog, it offers tips, projects, and more for electronics hobbyists. You can order kits (from Ramsey and other manufacturers) and parts, and read advice from The Wizard of Newtown, Captain QRP, and Professor Quad. Get a copy from Debco Electronics, Inc., 4025 Edwards Road, Cincinnati OH 45209.



MCM Adds Philips ECG Semiconductors

MCM Electronics proudly announces that Philips ECG is the newest in their line of top quality products. MCM stocks over 1,000 ECG items with access to their entire line—over 4,500 SKUs.

MCM has just released its newest catalog, #38, with 6,500 new items. New categories of Data Comm, Computer Software, Gaming, Printer Parts, Office Supplies, and Safety offer you new service opportunities. All MCM's trained sales representatives are professionals, available on toll-free lines to provide immediate service Monday through Friday, 7:00 a.m. to 9:00 p.m. EST, and Saturday 9:00 a.m. to 6:00 p.m. EST. FAXed orders are accepted 24 hours a day, every day. For complete information and a free catalog, call MCM Electronics at (800) 543-4330; FAX (937) 434-6959.

Continued on page 88

Number 64 on your Feedback card

Ham Radio Fun

Communications Simplified, Part 20

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

If you examine **Fig. 1** carefully, you will note that the sampled signal at the bottom of the figure consists of pulses, and that their amplitude is proportional to the amplitude of the analog wave at that point. You will also see that the tops of these pulses are sloped the same as the analog waveform was at that point. In most cases, this slope is entirely unnecessary, since the circuit which does the reconstructing of the pulses will supply its own slope; hence the pulses in most systems will generally have flat tops. Furthermore, since the slopes of the tops are unimportant, only the height (amplitude) of these pulses is important; the pulses can therefore be very narrow. This makes it possible to squeeze many other pulses between them, thus allowing more different channels to be multiplexed together (but note that this rapidly increases the required bandwidth).

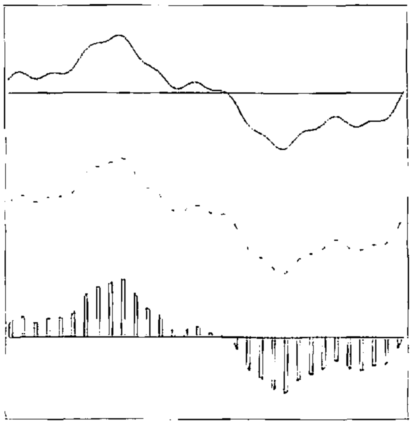


Fig. 1. Sampling an analog waveform.

The pulses in **Fig. 1** actually have another fault—some are positive and some are negative, which makes them difficult to send through some circuits. It is better to make all the pulses the same polarity, as shown at the bottom of **Fig. 2**, by adding a fixed DC voltage to the original analog signal; this changes it from pure AC to pulsating DC.

PAM: Pulse amplitude modulation

The result is then called PAM or pulse amplitude modulation, since it is the amplitude of the pulses that tells us what the voltage should be. PAM is a sort of electronic mongrel—it is partly digital and partly analog. The timing and the fact that it consists of pulses makes it look digital, but the amplitudes which preserve the voltage levels are purely analog. So PAM permits us to do time division multiplexing, but is still subject to many of the same problems as analog transmission would be, including noise, distortion, etc., because the heights of the pulses can become distorted as the signal is sent through different circuits and communications media.

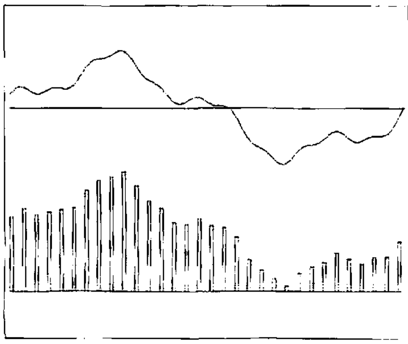


Fig. 2. Pulse amplitude modulation (PAM).

PWM: Pulse width modulation

Rather than modulate the amplitude of each pulse, we can change the width of the pulses; this results in pulse width modulation or PWM, which is shown in **Fig. 3**. A pulse is wide when the amplitude of the original signal is high, and narrow when the amplitude is low. (Note, by the way, that the sampling rate in **Fig. 3** is much too low. The Nyquist sampling theorem states that there should be more than two samples taken during the fastest cycle of the waveform. We have circled what looks like a fairly small/fast cycle, and there are not two complete samples in that small interval.)

As you can see from the small "tick" marks under the pulses, the leading edges of the pulses are evenly spaced; it is the trailing edges that move back and forth to vary the width of each pulse in our example. There are variations of PWM which move only the leading edge, or which move both edges to vary the width.

PWM has some advantages over PAM. Since all the pulses are the same height, PWM can be sent through digital circuits which would otherwise ignore or alter pulse heights. A PWM signal can be fairly easily converted back to an analog signal by passing it through an "integrator" circuit, that is, a circuit which measures the area under each pulse and converts that area to a fixed

voltage. It can also be easily analyzed by digital circuitry, which can measure the width of a pulse fairly accurately by measuring its timing.

Nevertheless, PWM is still only an analog-digital hybrid. Any kind of distortion which slightly changes the width of a pulse will distort the signal. PWM therefore has fairly limited uses in communications. One fairly common use is in high-power amplifiers or power supplies. Since the voltage in a PWM signal is either at zero or at full height, there are no in-between states. When such a signal is amplified by a transistor, the transistor is either fully off (when the current through it is zero) or fully on (when the voltage across it is very close to zero). The power lost in a transistor is the product of current times voltage; if one or the other of those two is zero or close to zero at all times, their product is small, and the power dissipated in the transistor will be small. This allows the amplifier to provide a high power output signal without itself losing much power in the process.

PFM: Pulse frequency modulation

Pulse frequency modulation is another analog-digital hybrid; here the frequency of the pulses depends on the analog signal's voltage, as shown in **Fig. 4**.

PFM is very similar to FM, where the frequency of a carrier also depends on the analog signal being transmitted, but instead of a sinusoidal carrier, we have rectangular pulses. PFM is sometimes used in instrumentation and measurements, but its use in communications is usually associated with FM. For example, there are some FM detector circuits which convert FM to PFM, and then use digital circuits to measure the frequency and convert it to an analog signal.

All-digital methods

All of the methods we've looked at so far—PAM, PWM, and PFM—have been mixtures of analog and digital techniques. The value of an analog signal affected either the amplitude, width, or frequency of pulses, in a continuous or analog fashion. By this we mean that the amplitude, width, frequency, or whatever, could take on a continuous set of values; there could be an infinite variety of amplitudes, widths, or frequencies. The problem with these approaches is that small circuit errors, which might produce slight changes in the amplitude or width or frequency of a pulse, cause errors in the signal.

Now it is time to look at the purely digital methods. In a digital system, there is a limited number of possible amplitudes, widths, frequencies, or whatever, in a signal. For example, in most computer circuits, there are only two voltage levels: one that we call a low, and another one we call a high. The low is usually close to zero volts, while the high is usually somewhere between +2 and +5V. The beauty of this scheme is that the precise voltage of a high or low is not important, so that slight imperfections in a circuit which might change, for instance, +5V into +3V make no difference because a high is a high is a high. But changing a high into a low, or vice versa, is catastrophic, so if the change is large enough to change +5 to 0V, then all Hades breaks loose. Fortunately, with careful design, we can avoid most such huge errors.

We have already discussed binary numbers, so let's just add that these highs and lows generally represent the ones and zeroes of binary numbers. (The high is usually a 1, while the low is usually a 0, but beware: there are many, many places where the high is the 0 and the low is the 1.)

PCM: Pulse code modulation

We can now see how PCM or pulse code modulation works. We sample an analog signal (using the Nyquist sampling theorem to tell us how often to sample) just as before. But instead of using each sample to control some analog characteristic of a pulse, such as its amplitude or width, we convert that sample into a code—usually a binary number. Although there can be some errors in the conversion process itself, once the conversion to a digital code is done, that code can then be stored or transmitted with absolutely no additional errors (as long as we are careful).

The modern telephone network is a prime example. Before the 1970s, transmission over the long-distance telephone network was analog. Cross-country connections were noticeably noisier and more distorted than speaking with someone across town. Today, your voice

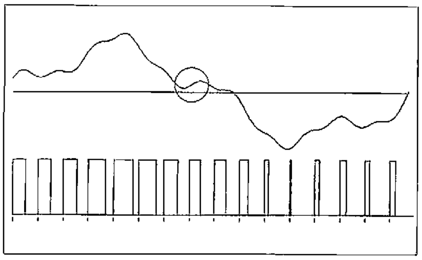


Fig. 3. Pulse width modulation (PWM).

is digitized as soon as it enters your local telephone company central office (and sometimes even sooner!). It is then carried as a digital signal almost all the way to its destination. The distance it travels is unimportant, because the data arrives at its destination exactly as it left your town. You can no longer tell the difference between a local call and a long-distance call just by the quality of the connection (and, despite what some telephone carriers will tell you, it has nothing to do with whether the connection is through a fiber cable).

Fig. 5 shows how it's done in a CD recorder and CD player. As the analog music signal comes in, a sample-and-hold circuit grabs samples of the input signal's voltage at the sampling rate. It then holds that voltage constant (even while the signal itself is changing) long enough for an analog-to-digital converter (also called an A-to-D converter, or just ADC) to measure the voltage and convert it to a binary number. This process is called quantizing. The resulting binary number is sent through a communications channel (or, in the case of a CD, recorded on the disc). Eventually, it goes back into a digital-to-analog converter (also called a D-to-A converter or DAC), which converts it back into an analog signal. But this signal has jagged edges because it has been quantized. Fortunately, the jagged edges represent frequencies above one-half of the sampling frequency (and therefore above

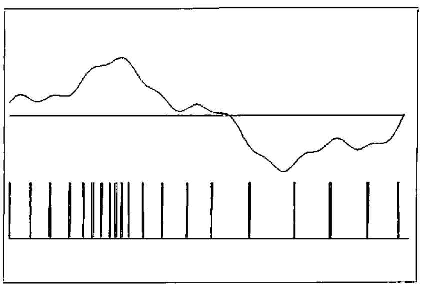


Fig. 4. Pulse frequency modulation (PFM).

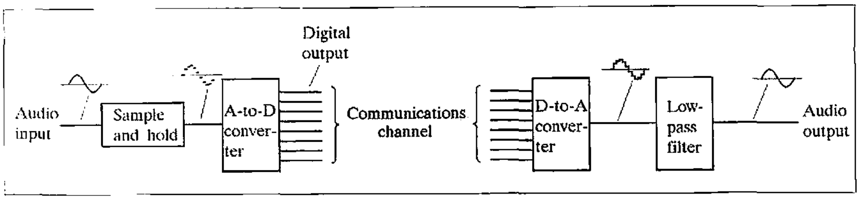


Fig. 5. Sample-and-hold and ADC.

even the highest frequency of the desired signal), so they can safely be filtered out without removing any desired signal. The result is then the original audio.

The ADC cannot, however, capture the exact value. When it quantizes the voltage, it can only express it to the nearest allowable digital number, and so it generates a quantization error.

To understand quantization error, think of shoe sizes. My foot is bigger than a size 11 shoe, but smaller than a size 12. If I wanted to order a pair of new custom-made Bruno-Magli shoes from the manufacturer, I could trace the outline of my foot on a piece of paper and send that as a measurement. This would be an analog measurement which, if only I could perform it exactly, would be an exact representation of my foot size. The problem is that temperature or humidity (or the vagaries of the post office) could slightly change the size of that paper, so that the manufacturer might send me the wrong size.

So I choose to measure my foot instead, and send just the measurement. Unless my letter is grossly mangled by the post office, that measurement will get to the manufacturer and still be readable. But the problem is this—how good is the ruler I use to measure my foot size, and how much space do I have to write down that size?

If I had a perfect ruler, I might find that I have a size 11.62729577953221459 ... foot, where the periods (called an ellipsis) denote that there are more digits than I have written down. In fact, my measurement might require an infinite number of digits, but the manufacturer obviously doesn't need all of them (nor do I have the room for them in this chapter).

But suppose I only have a ruler calibrated to the nearest inch. I must now decide whether my foot measures 11 inches or 12 inches. Whichever one I choose, there is a slight error and the shoe will not quite fit. This slight error is called quantization error. I can reduce the error somewhat by using a better (more expensive) ruler which has marks smaller than one inch, but I will now also need more room to write the measurement down.

The analog-to-digital converter works the same way. Whatever the input voltage is, it can only measure the voltage to the nearest step size. Moreover, the number of possible measurement values depends on the number of bits it outputs. If the converter had only a one-bit output, which could therefore be either a 0 or a 1, there would only be two possible "sizes." With just one output bit, the converter could only specify two possible voltage levels; in-between voltages would have to be assigned to one of those two allowed levels.

With a two-bit output, on the other hand, the ADC could measure four different analog voltages: for example, the bits 00 could mean "very small," 01 could mean "medium," 10 could mean "big" and 11 could mean "very big." But in-between voltages must still be assigned to one of those four allowed levels.

Just as using n bits allows us to specify 2^n different binary numbers, so using n bits allows the ADC to specify 2^n different values of voltage (for instance, two bits can specify 2^2 or four different voltage levels).

To see what this means, let's suppose that we have a converter which has a three-bit output; it can therefore detect eight (2^3) different voltage levels. Look at **Fig. 6** to see what this would mean.

At the top of the figure, we have the same analog waveform we have seen in previous figures. The tick marks show us when the sample-and-hold circuit and the A-to-D converter sample the input signal. At each tick mark, the ADC looks at the analog signal, and assigns it (quantizes it) to the nearest of the eight voltages it can distinguish. (Most converters actually use the next lower value, rather than the nearest value.) These eight levels are labeled with their binary equivalents, from 000 for the lowest to 111 for the highest. The output from the ADC would therefore be the series of numbers 100, 101, 100, 101, 101, ... as shown at the top of **Fig. 6**.

In other words, the gradual changes in the input voltage that occur between samples are ignored; the ADC only sees the signal as it exists at the instant it is sampled. As far as the ADC is concerned, the signal might as well be the squared-up wave that is shown superimposed over the analog signal in **Fig. 6**. When the digital signal is eventually converted back to analog, we will get this squared-up signal, but the filter circuit in the output will round off the sharp corners.

The problem, of course, is that the squared-up wave (even after it is rounded off again at the end) is not quite the same as the original analog signal, and this introduces an error. You can think of this error either as distortion, or as noise, that is, a signal which simply shouldn't be there.

The bottom curve in **Fig. 6** plots the difference between the original analog signal, and the squared-off quantized signal that the ADC thinks it sees—this is the noise or distortion. Let's try to compute its size in terms of the voltage steps that the ADC can detect.

The maximum peak-to-peak amplitude of the original analog signal is eight divisions. The error signal at the bottom of **Fig. 6** has a maximum peak-to-peak amplitude of two divisions. But notice that this signal has very sharp tips at its maximum and minimum points; after the filtering that occurs at the end, those peaks will be rounded off, and the peak-to-peak amplitude of the error will be less than one division peak-to-peak.

We now have a peak-to-peak desired signal level of eight divisions, and a peak-to-peak noise level of roughly one

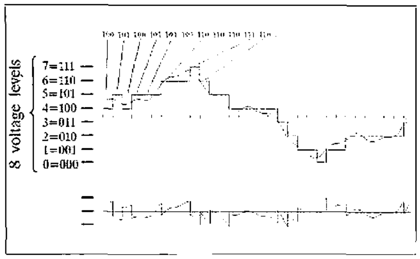


Fig. 6. Calculation of error and signal-to-noise.

division (or less). The signal-to-noise ratio is then about 8-to-1; which works out to

$$20 \log \frac{8}{1} = 20 \times 0.9 = 18\text{dB}$$

In this case, we had three-bit numbers giving us 18dB signal-to-noise ratio. If we repeated this calculation for different numbers of bits, we would note that, as a general rule, each bit in the binary number will give about 6dB of signal-to-noise ratio.

Let's now return to the compact disc. In the CD recorder, the analog-to-digital converter generates a 16-bit number, and is accurate enough to quantize 65,536 different voltage levels (since 2^{16} is 65,536), which gives us a signal-to-noise ratio of about 16 x 6, or 96dB.

To achieve a frequency response to 20,000Hz, the audio is sampled at 44,100 times per second. But since the CD is stereo, all of this happens for both the left and right channels. We now have 44,100 samples per second, times two channels, times 16 bits per sample, or a total of 1,411,200 bits per second. This is about 85 million bits per minute, or about 6 billion bits for the complete disk (slightly over 70 minutes).

This large number of bits would not be needed if we were willing to accept lower quality sound. For example, since the telephone network does not need hi-fi quality to 20kHz, or a 96dB signal-to-noise ratio, it uses many fewer bits. For a frequency response to slightly under 4000Hz, the telephone companies sample 8000 times per second. Seven bits are quite adequate for voice quality sound, so telephone company A-to-D converters only recognize 128 different levels, and output seven-bit binary numbers. Over one second, we then have 8000 samples, times seven bits per sample, or 56,000 bits per second—much less than the CD.

With 128 levels, the resulting signal-to-noise ratio is about

$$20 \log \frac{128}{1} = 20 \times 2.1 = 42\text{dB}$$

(or again about 6dB per bit). This isn't anywhere as good as a CD, but still perfectly adequate for voice communications.

Compression and expansion

Compression involves changing a signal or data in some way so as to use less space to store or transmit it. At the receiving end the process is usually reversed to uncompress (expand) the signal or data to bring it back to its original state. This compression/expansion process can fall into two categories: lossy and loss-less.

• In loss-less compression, the expansion exactly reverses the compression, so that the final result is exactly the same as the original. Loss-less compression is generally used for computer data, where changing even just one bit can completely ruin a program or data file.

• With lossy compression, the expanded data may be slightly different from the original. Lossy compression is generally used for data intended for humans, who can usually tolerate slight differences in sound or pictures.

Compression/expansion can be done on both analog signals and digital data.

Radio stations provide a good example of analog compression. The signal-to-noise ratio of a typical AM broadcast station is usually much less than that of a CD recording (especially one of classical music). If they turn up the volume so that the very weak portions of music are above the radio signal's noise level, the very loud portions of the same recording will overmodulate and distort. If, on the other hand, they turn down the volume so that the loud parts produce 100% modulation, then the soft passages will be below the noise level and become inaudible. Radio stations therefore often use a compressor to reduce the dynamic range (the difference between very loud and very soft sounds) of a recording. The compressor automatically turns up the volume on soft sounds, and turns it down on loud sounds. Since there is no expander in your receiver, no expansion is ever used.

In the digital world, most compression methods look for repetitive patterns in the data. For example, certain combinations of letters, such as *th* and *ing*, appear fairly often in the English language. We could save space by simply replacing each such string by some special character, such as perhaps ¶ or §. Like other extended ASCII characters, these special characters take eight bits each; even better compression could be achieved by replacing very common strings with even shorter bit patterns, perhaps using just a few bits. As long as the expansion process then replaces each special code by the original string, we can reconstruct the original without loss. It is entirely possible to compress plain text by a factor of 2-to-1 or 4-to-1 (meaning that a compressed file takes only 1/2 to 1/4 as much space as the uncompressed file). Some files (especially if they contain long strings of spaces or blanks) can be compressed even more. If you're into computers, then you may know about "zipping" files (using the PKZIP program to compress, and PKUNZIP to later expand) as an example of a loss-less compression. It compresses computer files so they take up less room on a disk.

But loss-less compression does not work if there are no repetitive patterns in the original data, because then it is not possible to come up with short codes for often-used patterns. Loss-less compression also seldom achieves more than a 5-to-1 compression (though greater compression is possible on certain types of files).

This is where lossy compression comes in. Lossy compression does all of the above, but it also examines the data to see whether there are details in it which are not needed and which could be eliminated. This is a matter of judgment, though—a compression method which might work for sound files might be disastrous on a picture file.

There are several common lossy compression methods in use. For example, Sony developed an audio MiniDisc—a compact disk which is about half the size of a normal compact disc, and stores just 1/5 as many bits, but can hold the same 74 minutes of music. It uses a compression method called ATRAC, which splits the 20kHz bandwidth audio signal into 512 smaller frequency bands, analyzes which bands have either no signal, or a soft enough signal that it would be masked by some louder sound elsewhere, and then eliminates those judged unhearable. The resulting signal is different from the original, but in ways that only a careful side-by-side comparison can detect. And even then, many listeners can tell the difference between the original and the ATRAC-modified sound, but cannot always tell which sounds better.

Another example is the JPEG system for compressing still computer pictures

(or MPEG compression for motion pictures). Because the eye is not particularly sensitive to certain kinds of picture distortions which affect color or sharpness. JPEG and MPEG achieve much greater compression than most other methods—compressions of 50-to-1 or 100-to-1 are not unusual. After JPEG or MPEG compression and expansion, the picture is not quite as sharp or detailed as it started, but the changes are usually small enough that most people are not bothered very much by it (although certain kinds of pictures are very badly affected).

Zipping, JPEG, and MPEG compression are not usually performed "real-time." That is, they are not performed as the data is being generated or used. First you generate digital data in its original form, and then, at some later time, you go back and compress it. Part of the reason for this is that these compressions take time, and today's hardware isn't fast enough to do the compression while the original data is being generated. That will undoubtedly change.

Other methods, though, can be performed real-time. Sony's ATRAC, for example, works in real time. A MiniDisc recorder can compress the sound signal while it is being recorded, and expand it while it is being played.

A-law and µ-law compression

In telephone applications, A-law and µ-law compression are specially designed for digitized voice to reduce the apparent distortion without increasing the number of bits.

With even spacing between the quantization steps, as in the top curve in **Fig. 7** (which shows only sixteen steps, though normal telephone audio uses 128 steps), loud sounds (those having a large peak-to-peak value, and shown at the left) are quantized with far more steps (and therefore much less distortion) than weak sounds (shown at the right). This is the opposite of what we normally get with analog methods, where softer sounds tend to be clearer and less distorted than loud sounds, and it sounds unnatural.

The solution is to change the spacing between quantization steps so that the steps in the middle are closer together. A small waveform will now be quantized with finer steps, and its shape better preserved than before. The bottom curve in

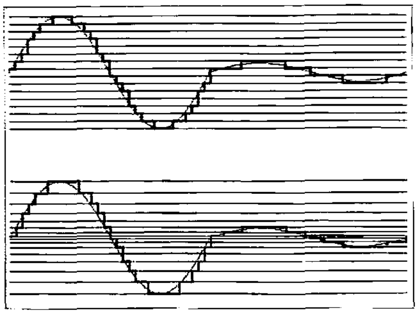


Fig. 7. Use of unequal steps in quantizing.

Fig. 7 shows the effect. There is a bit more error in the large wave at the left, but this is outweighed by the better accuracy for the smaller wave at the right.

Obviously, both the compressor in the sender, and the expander in the receiver, must know what the step sizes are, so that the expander can properly rebuild the waveform from the digitized samples. This process of compressing an audio signal at the transmitter end, and then expanding it at the receiver end, is called companding.

A-law and µ-law companding both work the same way, but their step sizes are slightly different. A-law companding is primarily used in Europe, whereas µ-law companding is the US standard.

Fig. 8 shows another way to look at this process. Rather than design the A-to-D and D-to-A converters to use variable size steps, let's imagine that the input audio signal (just before a normal A-to-D converter) is passed through a nonlinear circuit which slightly boosts small voltages, and slightly reduces large ones.

Fig. 8 shows the transfer function (that is, the relation which tells what the output voltage will be for any particular input) of such a circuit. The horizontal axis shows the input voltage (zero is in the middle, while negative input

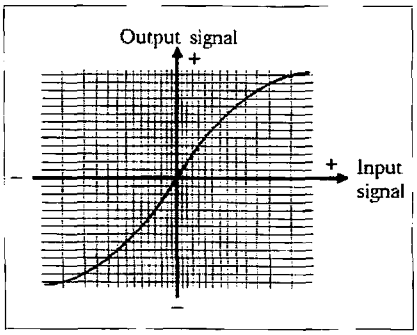


Fig. 8. Compressor transfer function.

voltages are to the left and positive voltages to the right). The vertical axis plots the output voltage, with plus at the top, minus at the right, and zero in the center.

The result is that small signals, which only move slightly to the left or right of the zero (the center of the figure) are stretched out so they take up more steps of the A-to-D converter's input. In other words, instead of shrinking the step size for small signals, this nonlinear circuit stretches small signals to fit the equal step sizes of the converter.

At the receiver, an opposite circuit would treat the audio signal coming out of the D-to-A converter, doing the exact opposite—reducing small voltages and increasing large ones. This circuit restores the audio signal to its original shape.

This method of companding works quite well for telephone-quality voice signals, and makes a noticeable difference in audio quality.

DPCM: Differential PCM

Differential Pulse Code Modulation or DPCM is basically PCM but with digital compression to reduce the number of bits required to carry the information without actually changing the accuracy.

The idea hinges on the fact that, for most analog waveforms, any two successive samples are usually fairly similar. In other words, the difference between any two successive samples is fairly small—and definitely smaller than the overall size of the waveform. Hence the number of bits needed to specify the difference between two samples is smaller than the number of bits needed to give the entire value of each sample.

For example, in **Fig. 6**, we saw that the first few quantized steps in binary were 100, 101, 100, 101, 101, 101, 110, 110, 110, 111, 110, etc., each of which required three bits. In decimal, these are the numbers 4, 5, 4, 5, 5, 5, 6, 6, 6, 7, 6, etc. Once we know the first value (4), we can specify the others by giving only the differences from the previous number. For example, the second number is 101 or 5, which is the previous number (4) plus 1, so we would write +1. The sequence would then be +1, -1, +1, 0, 0, +1, 0, 0, +1, -1, which would require fewer bits than expressing

the entire sequence 100, 101, 100, etc.

As we've already seen, the system only works if successive samples are fairly similar—since there aren't big jumps from one sample to another, only a few bits are needed to specify the difference. The system breaks down if there are many sudden jumps between samples, but this doesn't generally happen with speech or with most audio.

MPEG compression for motion pictures uses a similar concept. In most film or TV action, there is little difference between one frame and the next. Rather than fully describe each of the 30 or so (depending on the method) frames per second, MPEG compression compares each frame with the one before it, and describes only the differences. Occasionally, when a scene changes, the MPEG data must provide a much greater amount of data to describe an entirely new picture, but this is relatively rare.

Delta modulation

Delta modulation is an extreme case of differential PCM. In delta modulation, the sampling rate is much higher than required by the Nyquist theorem. We use the term oversampling to describe it—for example, a system where the sampling rate is 16 times higher than the minimum required would be called "sixteen times oversampling."

At first glance, this sounds bad: taking more samples than necessary implies more bits than necessary. The difference, however, comes in the number of bits needed per sample. If you sample fast enough, the difference between successive samples becomes so small that there is at most a one-step difference between any two successive samples. Then you need only one bit to express that difference.

The previous paragraph is not entirely correct; it's a bit over-simplified. Actually, we need slightly more than one bit to express the difference between two successive samples. The reason is this: A given sample measurement could be either (1) larger than the previous sample, (2) smaller than the previous sample, or (3) the same as the previous sample. One bit can only express two possible conditions, not three, so you need more than one bit.

Delta modulation, however, ignores the third possibility—the case where one sample is the same as the previous one. When there are several samples of the same value, instead of coding them as "same, same, same, same," delta modulation introduces a slight wiggle into the waveform by coding them as "bigger, smaller, bigger, smaller." By using a 1 to mean "bigger" and a 0 to mean "smaller," delta modulation gets by with just one bit per sample.

Fig. 9 shows an example, illustrating two kinds of possible errors. At A, we see that the analog signal is rising faster than the digital approximation can follow. This can happen if the system does not sufficiently oversample. This error could be reduced by increasing the sample rate (which, unfortunately, requires more bits) or increasing the step size (which, unfortunately, would reduce the signal-to-noise ratio).

At B, we see that the analog signal is almost constant. Ideally, the digitized signal should also remain constant. But because the bit coding in delta modulation requires that the digitized waveform cannot stay constant—it must go either up or down—this introduces a slight "wiggle" which adds a slight amount of noise into the signal. Fortunately, with oversampling the sampling frequency is much higher than the highest signal frequency (for example, with 16 times oversampling, the sampling frequency would be over 32 times higher than the highest signal frequency). The frequency of this "wiggle" is therefore way above the signal range, and so it can easily be filtered out with a low-pass filter.

Delta modulation has one major advantage: It greatly simplifies the design of the A-to-D and D-to-A converters, and this drops the price. A moderately fast microprocessor can easily convert back and forth between plain PCM and either DPCM or delta modulation, making it possible to use delta modulation even when data is coded with PCM. That's why you often see CD players advertised as using oversampling—they use an inexpensive microprocessor to convert the PCM on the CD into delta modulation, and then convert that to audio with a simple one-bit D-to-A converter. This can give somewhat better results than a 16-bit D-to-A converter costing the same.

Vocoders

In wireless applications, bandwidth is becoming so scarce that the US government has been auctioning off RF frequencies to the highest bidder. We have already discussed how high-definition television (HDTV) will use digital methods to compress a high-resolution picture into the same 6MHz bandwidth currently used for normal TV.

Another bandwidth crunch exists in voice communications, such as in the mobile radios used by trucks, taxis, and police, and in cellular radios and PCS—the Personal Communications Service which is being developed in parallel with normal cellular phones. This has led to the development and use of vocoders.

Normal speech can be broken down into several dozen basic sounds called phonemes; words are then put together out of these phonemes. The vocoder or voice encoder is a device which produces phoneme sounds like those which might be produced by a speaker's mouth. It does not try to duplicate a particular waveshape, but rather is told by a digital data stream what sounds to make. (There is obviously another side to the vocoder, and that is the part that can analyze an actual voice and break it down into its components.)

Whereas normal telephone company digitized voice signals require 56k bits per second, vocoders using just 13kbps are fairly common, and substantial progress has been made at units which can work with just 8kbps of data. Current vocoders produce speech that sounds slightly unnatural, but that is close enough that most users can recognize not just the words, but also the voice of the original speaker. The ultimate goal is to reduce the bit-per-second rate even further, so that mobile communications bandwidths can be reduced from their current 15kHz down to 7.5 or even less.

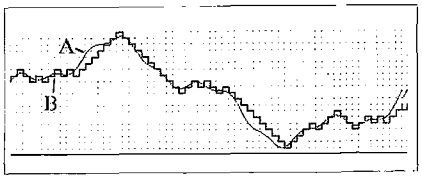


Fig. 9. Delta modulation.

Oscillator Basics, Part 1

Some things every ham should know.

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266

Oscillators are magical little circuits that generate the signal we transmit via radio; without the oscillator there would be no signal to transmit or receive. Actually, the oscillator is an amplifier that has its output coupled back to its input (**Fig. 1**). Though the circuit will oscillate, the frequency of oscillation is uncontrolled—it will be at the highest frequency the amplifier can support.

Selected components in the feedback circuit will provide control of the frequency. In the case of a crystal oscillator, the crystal operates as a resonant circuit, placed in the feedback path of the amplifier to control the frequency and stability of the oscillation.

Fig. 2 shows how a crystal is used; there are two resonant modes from which to select. **Fig. 2a** shows an anti-resonant (parallel) crystal; it exhibits a 180-degree phase shift across its terminals (high impedance). **Fig. 2b** shows a resonant (series) crystal, which exhibits a zero degrees phase shift across its terminals (low impedance). In either case, the amplifier must provide a like amount of phase shift, canceling out the circuit losses, to sustain oscillation.

Because of circuit variables and differences between crystals, some oscillator applications require adjustment or "netting" of the operating frequency. The method most often used is placing a capacitor or inductor in the crystal circuit to "pull" the crystal frequency to that desired.

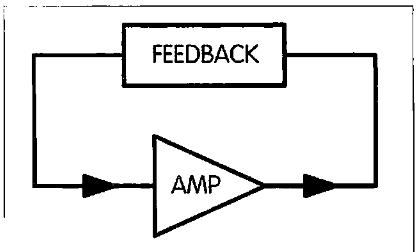


Fig. 1. Oscillation (feedback) is amplifying the same signal over and over.

Fig. 3 shows some of the methods used. A capacitor or inductor is placed in series with a resonant (series) crystal (**Fig. 3a**), and is placed in parallel with an anti-resonant (parallel) crystal (**Fig. 3b**). The capacitor or inductor, when added to the crystal circuit, will shift the crystal frequency predominantly in one direction from nominal.

Note that a resistor is placed in parallel with the series-resonant crystal, particularly when used with a series-connected capacitor, to maintain a conductive path for bleeding off trapped electrons. The crystal is a non-conductor, and when in use, electrons will build up on the isolated circuit conductor between the crystal and capacitor, and the number of electrons (voltage) will increase with continued use and apply a DC bias to the crystal.

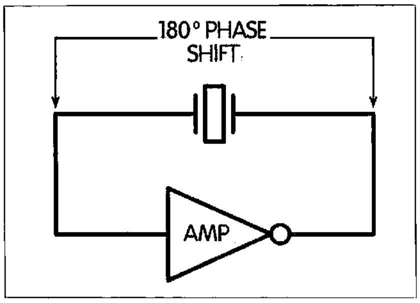


Fig. 2a. Anti-resonant crystal.

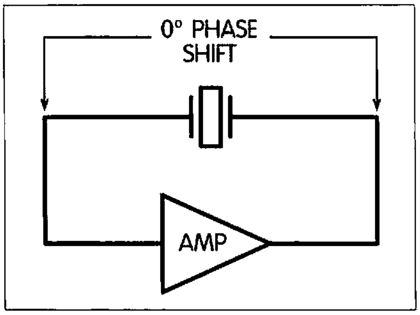


Fig. 2b. Resonant crystal.

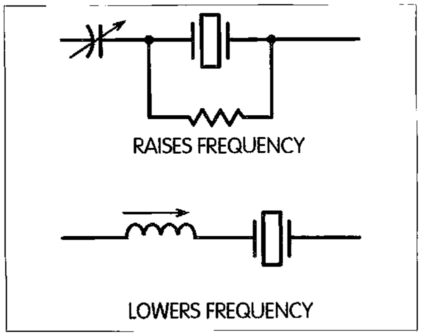


Fig. 3a. Resonant.

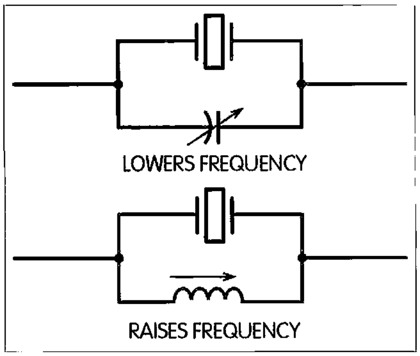


Fig. 3b. Anti-resonant.

Eventually, the excessive bias may apply sufficient pressure to fracture the quartz, but in the meantime, the crystal frequency will shift uncontrollably. A shunting resistor (any value between 100 and 2000 ohms, 680 ohms being typical) provides a conductive path, relieving the voltage strain on the crystal.

Some circuit designers use a small RF inductor across the crystal to accomplish the same purpose as the resistor. Again, the value is not critical, but the inductor's impedance value must be at least ten times the crystal's operating impedance. ■

Frequency and CW CQs

How to zero-beat your transmitter.

Bob Shrader W6BNB
11911 Barnett Valley Road
Sebastopol CA 95472
[W6BNB@aol.com]

Back in the early days of radio, before World War I, and for some years after it, the transmitters most hams used were called "spark sets." In many cases, they used power-line AC with no special power supplies other than a high-voltage step-up transformer.

When each half cycle of the power line AC cycle built up to a high enough voltage, the transmitter's spark gap would spark across. For a few milliseconds a damped (decaying) radio-frequency (RF) AC oscillation would be produced in the transmitter/antenna coil and capacitor network, pretty close to the frequency of resonance of the transmitter's antenna inductances (L) and capacitances (C).

Because of the weird damped waveform of the RF-AC oscillations, both a "carrier wave" and "sidebands" (RF-AC waves above and below the carrier frequency) could be heard perhaps 100kHz (or more for nearby receivers) from the LC circuit's fundamental frequency. It was a terribly broad buzzing sound emission.

We have improved greatly on our transmitting equipment today. A modern CW transmitter is capable of operating, key down, on a single frequency, producing no sidebands at all. However, if it is keyed, it does develop a few sidebands. The old spark transmitters produced damped waves and for this reason their radiotelegraphic code transmissions could not be called CW because "CW" stands for Continuous (non-varying) Wave signals.

You probably know that today's AM broadcast band is from 550 to 1,600kHz. But let's turn the clock back and think for a while like the hams did back in the old days of radio. In those days, the frequency 550kHz was expressed as, "550 kilocycles-per-second," or simply, "550kc." Similarly, 1,600kHz was "1,600kc," or "1.6 megacycles-per-second," or simply, "1.6mc." Today, we would say it was "1.6MHz."

As a result, receivers accepted a very wide band of frequencies. If a spark station opened up on 600kc, any listeners within perhaps 50 miles would be able to hear him (few, if any, "hers" in those days) if their receivers were tuned anywhere between perhaps 400 and 1,000kc. So, the frequency on which a CQ was called was not too important. If a spark rig was operating, just about everyone anywhere around with a radio receiver would hear it. Answers could be expected to come from stations using a carrier frequency several hundred kilocycles away.

"*If a spark rig was operating, just about everyone anywhere would hear it ...*"

And what we know as 60Hz AC today was called 60 cycles-per-second, or 60cps then. Note that we now capitalize the M in mega (million), whereas in the early days they would use a lower-case m. The abbreviation for kilo (thousand) is still indicated by a lower-case k. The term "hertz," meaning cycles-per-second when used as a unit of measurement, is abbreviated "Hz." Of course, old Heinrich Hertz's name is capitalized as "Hertz."

No assigned frequencies

In the very early days of radio, there were no assigned frequencies. Operators used any frequency on which they could get a rig working. In order to pick up signals strong enough to operate earphones satisfactorily, the insensitive early crystal and other detector circuits had to be closely coupled to the antenna.

Because of unknown degrees of coupling from antenna to receiver or transmitter, the values given here can only be approximations. But what a wide swath two hams could cut in the radio spectrum—perhaps a whole megacycle! That's more than three times the width of our present 40m band.

It wasn't long before all of the amateur stations, plus a rapidly increasing number of broadcast stations, plus commercial radiotelegraph stations, plus all of the military services, began interfering with each other. Bands of frequencies had to be assigned for the different services. Commercial radiotelegraph and the military were assigned bands of frequencies below the assigned AM broadcast band (in those days, it was

stated as higher in "wavelength") than the BC band, which was roughly where it is today. Believing that the frequencies higher than the BC band were more or less useless, they assigned all of these to the amateurs.

In the second decade of the 20th century, the invention and use of the vacuum tube (VT) allowed this device to be coupled to LC circuits to produce RF-AC oscillations of a very pure sine-wave type. This resulted in the generation of radio frequency transmitter carriers with zero bandwidth.

Locally, the old spark sets, even with loosely coupled antenna circuits, had very broad carrier bandwidths. At some distance they may have only appeared to be perhaps 40kc on receivers, but that is still very wide by today's standards. If ships operated a high power spark transmitter on the international watch and distress frequency of 600m (500kc) when entering or leaving a port, they would wipe out some or all of the local BC station signals. Ships were required to lower their transmitter power when near ports.

A VT oscillator operating on a frequency, let's say 7mc, has zero bandwidth. However, when it is keyed, meaning it is turned on and off to produce dots and dashes, it goes from zero amplitude to maximum and back to zero. This is a half-cycle of square-wave RF-AC.

True, sine-wave-shaped radio waves from VT oscillators have no sidebands. But square-type RF-AC waves developed by CW keying do produce sideband RF-AC signals. Keying with a straight key may produce 6 square waves per second, or a 6cps square-wave AC. Such square waves are rich in harmonics of the keying frequency (unless a keying filter is used). If the 6cps square-wave RF-AC is limited by filtering to only 5 significant sidebands on both sides of the carrier, the bandwidth of the emission would be 6 x 5, or 30cps on each side of the carrier, for an overall bandwidth of 60cps. If the sending speed is doubled, the bandwidth of the signal doubles, but this is not much in comparison with an old-time spark transmission.

It wasn't long before hams found that they could generate pure RF-AC carriers on the frequencies they were allotted from the BC band to 10mc and above. (The L and C built into early-day tubes made operation above 10mc difficult, limiting higher frequency uses considerably.) Hams realized that high-frequency signals from their transmitters traveled up into the ionosphere and were either reflected or refracted (bent) back down to Earth many hundreds or thousands of miles away, providing distant (DX) communications without thousands of watts of RF power.

Not only did amateurs generate narrowband transmitted signals, but with the amplification provided by vacuum tubes, they could also use loosely-coupled and therefore more sensitive and narrower bandwidth receivers. These might be made to tune over a wide band of frequencies, perhaps from 2 to 7mc with one coil and one variable "condenser" (capacitor). The amateur frequencies from 2 to more than 10mc were about 8 times the width of the BC band, and 15 times the width of all of the frequencies allotted to the commercial and military radiotelegraph services.

Wide allotment

At first, with their wide allotment of frequencies, if one ham called CQ on 3mc and was answered by another using a 4mc transmitter, it took a long time for the 3mc ham to tune around and find the 4mc answering frequency. So CQs were sent for long periods of time and much time was spent trying to find an answering call. They soon learned how important it was to adjust the frequency of their transmitters as close as possible to the CQing station's frequency. (We are still talking about times before and shortly after WWI.)

Since the amateurs were able to communicate over long distances using high frequencies, it wasn't long before the commercial and military services decided they wanted to operate on these frequencies, too. So, other frequency allocations had to be made. This time the higher frequencies were divided into amateur bands and separate bands of frequencies for each of the other services.

The amateur frequencies started at 1.75-2mc and were known as the 160m band. The other bands, all harmonically related, were the 80, 40, 20, 10, 5, and 2.5m bands. They were also known as the 1.75, 3.5, 7, 14, 28, 56, and 112mc bands. If an amateur decided to operate on a good daytime and nighttime band, such as the 40m (7mc) band, he would only have to tune over a couple of hundred kilocycles looking for a response to his CQ.

Later, when the amateur CW bands were sectioned off with parts in which radiotelephone could also be used, a CW CQ on 7.05mc might only require searching from 7 to perhaps 7.1mc with a receiver. That is still quite a wide band of frequencies to have to search for answering calls.

"Let's not be band hogs! Make sure you are zero-beat!"

In the 1930s, '40s, and '50s, a great many amateur transmitters were "crystal controlled," meaning that they put out RF-AC only at the frequency (or harmonics of that frequency) to which the crystal was "ground" (manufactured to oscillate). With no crystal near the frequency of a CQing station, an answering operator would be lucky if the CQing operator tuned that far to find the answer to his or her CQ (more girls were now getting into ham radio).

Mr. Hertz arrives

After WWII, the old cps, kc, and mc abbreviations were changed to our modern hertz, kHz (kilohertz), and MHz (megahertz) abbreviations. You may still hear old-time hams using the kc and mc designations, which sounds normal enough to them—although it may not to later generations. The OMs say, if "kc" stands for kilocycles-per-second, why add another letter, making it "kHz" to say the same thing? But languages other than English may use other terms for "cycles," so the "c" in "kc" would be meaningless to them.

With the complexity of amateur radio equipment steadily increasing over the years, almost all modern "transceivers" can now transmit and receive on any desired frequency in one or all high-frequency amateur bands. Most transceiver receiving sections will track with their transmitting sections. If you transmit on 7.05MHz, your receiver should receive CW signals that are also on 7.05MHz, and produce a pleasing 700 to 800Hz audio output from them.

Unfortunately, some transceiver receivers are not detuned, or "offset" 700 to 800Hz from their transmitters. If an incoming signal is tuned to a pleasing tone, the transmitting section may turn out to be 700 to 800Hz above or below the CQing station's frequency. This may be far enough off with today's narrow passband receivers, some as narrow as ±250Hz, that the CQing station will not hear the answering station unless his or her receiver is tuned back and forth a kilohertz or so across the frequency on which the CQ was sent.

So, as in the old days, it may still be necessary to tune around after calling CQ to find an answering call. Some home-brew amateur transmitters still use crystal oscillators and may not be able to answer anywhere near the CQing station's frequency. If a variety of crystals of different frequencies are available, one may be close enough to the CQing station's frequency to hope that the answering call will be heard.

Many of today's transceivers have a built-in "Receiver Incremental Tuning" (RIT) control. RIT controls tune only the receiver, leaving the transmitting frequency unchanged. The RIT is a really handy circuit for both CW and SSB communicating. If your transceiver has an RIT control, after you call CQ on CW and hear no answering calls, turn on the RIT and move its control knob perhaps 1,000Hz each side of its zero or off position. That way you can tune in amateurs who are calling you, but unknowingly are not on your frequency.

They've got the (zero) beat

The subject of zero-beating is an interesting one. If two different RF-AC frequencies are mixed together at the input of the right kind of an electronic circuit, both of these signals will appear in the output circuit. But besides the original two frequencies there will be two other "beat frequencies" in the output. One will be the sum of the two original frequencies, and a second will be the difference between the originals.

Suppose a 7,001,000Hz signal is received and mixed with the output of an oscillator you can control. If you set your oscillator to a frequency of 7,001,700Hz, the audible beat frequency signal in the output of the electronic circuit, besides the original two frequencies, will be a pleasant-sounding 700Hz tone. The second output beat signal will be a "sum frequency" of 14,002,700Hz. This is far beyond the limits of our hearing (which is about 20kHz for young people, perhaps 8kHz for the elderly) and may be of no use to us in this particular case.

When you tune your transmitter to the same frequency as an incoming signal you are said to be zero-beating the two signals because no beat signals are developed. When your transmitter is zero-beat with another station's carrier you will be using the least amount of band space possible, usually something less than 100Hz when keying CW.

If one CW station is off another CW station's frequency by 800Hz, the two stations will be using about 900Hz of the band when communicating. They are using about nine times as much band space as two CW stations who were zero-beat. Let's not be band hogs! Make sure you are as close to zero-beat as possible with any station you are working.

Tricky business

Getting your transmitter to zero-beat with another station's carrier can be tricky. If you use a separate transmitter and receiver, when you tune in a CQing signal, first adjust your transmitter to very low power (or turn off the final amplifier if possible). Then tune it across the frequency of the signal being received. As you tune, you will hear a whistle that starts as a high audible tone, goes down to zero and then goes back up to so high a frequency that it is no longer audible. Retune to the zero signal condition and your transmitter will be very close to zero-beat with the other transmitter. It may not be exactly zero-beat because neither our receivers nor ears will respond to frequencies below perhaps 20Hz, leaving a dial spread of about 40Hz that we cannot hear.

Transceivers with receivers having a built-in offset of 700 to 800Hz from their transmitter's frequency, when tuned to a pleasing 700 to 800Hz beat tone, should be relatively close to zero-beat with that signal when transmitting. This is an excellent type of CW rig.

A problem arises when a transceiver's receiver is not offset from its transmitter's frequency, which may be the case in transceivers built for SSB operation with CW as more or less of an afterthought. When the listening operator tunes to a pleasant-sounding tone, the transmitter will probably be 700 to 800Hz above or below the CQing station's frequency. If the transceiver has an RIT control, there should be some RIT setting at which a pleasant-sounding CW signal will put the transmitter at zero-beat with the incoming signal. Always use this RIT setting when working CW. If there is no RIT control, as with some of the QRP kits, things become more difficult. With a little experimenting, it may be found that by readjusting the frequency control 700 to 800Hz between sending and receiving, two stations can operate on the same frequency. This does require retuning your rig each time you shift from transmit to receive, which is undesirable. Another possibility is to add a RIT control and switch, which takes a bit of doing. With so many different types of CW rigs in use it is impossible to explain how to zero-beat them all correctly. If you are not sure how to do it, experiment with another amateur on the air until you know how to adjust your transmitter to zero-beat the other station's frequency. Experimenting is the name of the game of amateur radio. Zero-beating is the only way to work CW properly.

As mentioned above, when operating SSB with a transceiver, as long as you have your RIT off, or not detuned, when you adjust the main tuning dial so that the received voice sounds most natural to you, your transmitter should be zero-beat with the other station's suppressed carrier frequency. The only time to use your RIT with SSB is when one of the stations in a net is not operating exactly on the net frequency and you have to tune until he sounds normal to you. This is where the RIT's on-off switch comes in handy: RIT off to listen to the net frequency—RIT on to hear the off-frequency station (whose RIT is probably on and detuned!).

Calling CQ

There is a basically proper method of calling CQ on CW. First, patrol for a minute or so a part of the band in which you want to work. Find a stretch of 2 or 3kHz that appears to be clear. If necessary, tune up there, send "test," and sign your call. If you hear "QRL," which means "This frequency is in use," move

your transmitter to some other apparently clear frequencies. Listen for about five seconds, then send "QRL?"—meaning, "Is this frequency being used?" If you hear "QRL" or "yes," move again. In many cases, you may not hear stations because they may be in your skip zone. If you hear no QRL, or "yes" answer, listen for about five seconds and then repeat the QRL? call. If there is still no answer, call "CQ CQ de" and send your callsign twice, slowly and distinctly, followed by a "K," meaning "go ahead." If there is still no answer, there is probably no one else monitoring that frequency and wanting to communicate.

Now send a full CQ call: CQ four or five times followed by "de" and your callsign once. Repeat the CQ calls and signing two or three times, ending with your call letters sent at least twice, very distinctly and well spaced, followed by K. Do not run your callsign characters together. With some of the weird callsigns we have today, it is easy to confuse someone if a callsign is repeated but not spaced properly. Be sure to space adequately between your callsigns! You may know your callsign, but the operator at the other end has to learn what it is!

Patience

Don't always expect to get a response on a first CQ call. After tuning back and forth across the frequency a few times to see if someone is answering but is not zero-beat with you, repeat the CQ call again. In general, don't make a CQ call last for more than 60 seconds. On a dead band, you may have to make the full CQ calls many times before you get a response.

Even kilowatt-transmitter operators may not get an answer after half a dozen calls, so don't give up easily if you are using lower power. You have to keep calling until someone happens to tune across your frequency while you are sending the letters "CQ." This is the reason why you only sign your call once in between CQ calls—it is so you will be sending CQ most of the time with minimal signing time. Don't send a long string of CQs with only a couple of signings at the end. Others may get tired of listening and tune off.

After two or three CQ call sessions, wait about 10 seconds, then patrol the band to see if there is someone calling CQ somewhere else. After half a dozen CQs, try moving your frequency a kilohertz or so to possibly pick up someone who is sitting on this new frequency.

Sometimes there may be a QSO in progress on the frequency on which you have been calling CQ, but you do not hear them because they are in your skip zone. Other operators may be in the position where they can hear both you and the other QSO in progress at the same time, but they will not answer you on that frequency for fear of interfering with the QSO. That same operator might answer if you were a kilohertz removed.

At the end of a QSO, some operators send "QRZ?" when they mean CQ. When you send QRZ? you are indicating that you have heard a station calling you but that you were unable to copy the call and you are requesting him to repeat his call. Other stations should not call you if some other station is already calling. If you want to have another contact after you sign clear of a station, merely send CQ twice and sign your call twice. If someone is listening who wants to contact you, this is the correct go-ahead indication.

It may be more desirable to answer CQs than to call CQ on a busy band. You can be more selective about who you will be working. Generally, if you want to rag-chew, stay out of the lower-frequency DX portions of the CW bands. Most DX stations only want a contact and may not be looking for a rag-chew. In years gone by, amateurs wanting to rag-chew would send, "CQ RCC," meaning CQ to the rag-chew club members, but we don't hear this any more.

Slow down

Always make sure that you send your CQs at a speed a little slower than you can copy comfortably. When in a QSO, make sure you send at a speed that the other operator can copy. If you ask questions but get no answers, slow down—you are probably sending too fast (or too poorly?) for that operator! If the other operator is making a lot of mistakes, he or she is perhaps trying to send too fast. Slow your sending and hope that the other operator does the same, or use the Q signal "QRS," which means, "Send slower." That will usually improve the sending of an operator who is told to slow down. Always use slower sending when you know the receiving operator is having QRN troubles.

A long way

We have come a long way since the early days of spark transmitters and those insensitive crystal detector receivers. Today, it is rare to find another station answering our CQ who, if not zero-beat, is more than one or two kilohertz from our frequency. But we should not forget that there are still some, usually home-brew, crystal-controlled transmitters in use, so it may be a good idea to search further away from your calling frequency sometimes to pick them up.

In the early days of radio, if there were 10 spark transmitting stations working at the same time in the two megahertz of frequencies that were in general use at that time, it probably would have been considered crowded conditions. Today, in the 150 kilohertz that we think of as being the 7MHz CW band, with our modern equipment we could probably squeeze in 150 separate QSOs at one time, involving 300 amateurs. This is not considering all of the other stations either in our skip zones or which are out of range.

While CW can be used legally on all parts of all amateur bands, many operators resent hearing CW being used on phone frequencies, or on frequencies used by other modes of communication. Let's use our amateur frequencies in such a way as to keep everybody at least reasonably happy. 73

Keys to Days Gone By

Enthusiasm for the code keeps this ham's nostalgic collection working.

Charles M. Seay, Sr.
106 South Main Street
Dickson TN 37055

People have their own reasons for becoming hams. It may have been the excitement of witnessing a DX contact, the prospect of owning and appearing on your own television station, the desire to rag-chew, or a love of code and the satisfaction that only a code contact can bring.

After a while, the best part of the amateur world is the nostalgia that goes with the hobby. Whether it's remembering that special contact, the construction of that first piece of equipment, or the collection of special segments of equipment, you can't be around two or more hams for fifteen minutes and not hear the phrase, "I remember when."

Nostalgia is a great part of the satisfaction that comes to those who collect and use different types of telegraph keys. They are always wondering who owned the key before it came into their possession, and what important message it may have sent. This is especially true of keys that were made and used during the great historical periods, such as the great world wars or some natural or man-made disaster.

One of those collectors of antique keys is Shelby Rye AD4WQ. While he doesn't have a huge collection of keys, his is unique in that he uses each key in his collection on a rotation basis. He loves the code. He now has 80 keys and six sounders, but he is especially proud of his collection of Martin Rotoplex and McElroy keys. One of his Martin Rotoplex keys carries a serial number 13, and his McElroy Deluxe Bug was manufactured in the late 1930s.

No key collection would be complete without a broad spectrum of straight keys. In this area, Shelby has a J-12 key with a history back to World War I, a J-38 straight key and a J-45 leg key from World War II, and seven Western Union legless keys of different vintages. Most of the keys were found at hamfests or through contact with families of silent keys.

A Bunnell KOB key with sounder sporting a pre-1900 manufacture date occupies a special place in collection of sounders. Many of his sounders were obtained through contact with retired railroad operators or their families.

Shelby was introduced to the wonderful world of amateur radio in February of 1994, took and passed his Novice test in April of that year, and was first licensed as KE4NFP. Before he received his first license, he had already passed the twenty-words-per-minute code test and all written exams for his current Extra Class call AD4WQ.

Shelby is known to other hams in middle Tennessee as Coach Rye. He is the men's basketball coach at the local high school. Coach Rye said, "Like basketball, learning the code requires the discipline to practice. I love to make at least five code contacts each day, with a yearly goal of 2,000 contacts." Before his introduction to amateur radio, Coach Rye collected knives and pocket watches. When I asked Coach Rye what he thought of amateur radio, he replied, "Without a doubt, it's the most captivating hobby I've ever been involved with."

Shelby operates a Ten-Tec Omni Six with all filters into a dipole 55 feet per side through a MFJ 949E Tuner. "I never run over 60 watts and I usually hang out on 40 meters between 7.030 and 7.040," said Shelby. He is a check-in most nights with the Tennessee CW Traffic Net on 3.635 at 7:00 p.m. CST.

Photo A. *Shelby Rye AD4WQ, at the operating position of his amateur radio station with a selection of keys on rotation.*

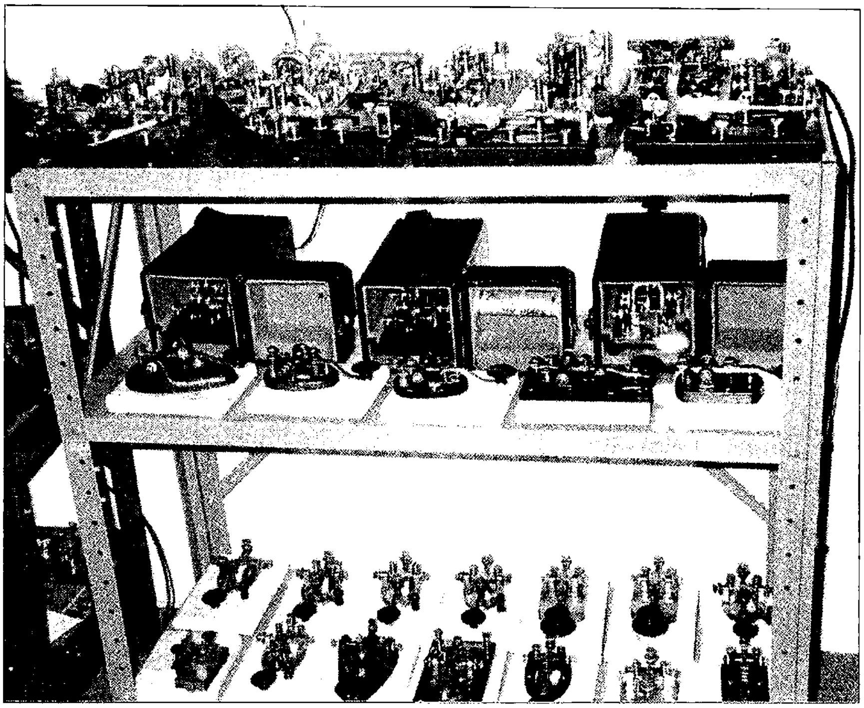


Photo B. Just one rack, showing some of the keys in Shelby Rye's collection. All keys are in working order and are used on a rotation basis.

Whether you collect keys, QSL cards, awards, or other equipment, nostalgia now plays or will play an important part in your amateur career. You can't operate an amateur radio station without encountering reminders of the past, whether it's the electronic theory, or equipment, or an old-time operator. Each person and each piece of equipment in the amateur radio service is unique. Who would have it any other way? 73

NEVER SAY DIE

Continued from page 56

fish, or anything that may come riding along with your strawberries or raspberries, both of which have been making people sick recently.

Dr. Farber sent me an updated edition of his *Silver Micro Bullet*, a book which is included in my guide to books you should read. Silver may be the best answer to the coming plagues brought on by escalating microbial resistance to antibiotics. I see that *The Plague Makers*, which I have reviewed, is now on the front page of the Barnes & Noble flyers at a discount price.

When am I going to hear from you about your adventures with silver? The April issue had a simple gadget for making the stuff.

DVD

I hope it's no news flash to you that we're going to be seeing an increasing flurry of digital video discs. They're the same size as CDs, but they hold over nine times more data, which has made it possible to put a whole movie on a single disc. They crammed the additional data on the discs by making the pits nine different depths instead of just one. With movies this will enable them to add different endings, sound tracks in several languages, comments on the production, and other trivia.

The discs will be lower priced than video tape, so as players come down in price we may see the movie renting public buying the new players. The pictures will be much better than on tape, and you don't have to fast forward or rewind to find something. No, you can't yet record your own.

Judging from the ubiquity of video rental stores, I'm one of the few people who doesn't rent movies. Or buy them, either. I go to the movies every week or so, and catch a few of those I miss in PrimeStar. I haven't missed very many good movies, but I *have* watched a bunch of turkeys.

I can't think of any good reason for me to get a DVD player yet. Heck, Sherry bought a video disc player and we've never used it. I do keep my VCRs busy. I rarely watch any shows live, preferring to time-shift them for my convenience and so

Continued on page 88

Number 78 on your Feedback card

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119
[clhough@pacbell.net]

Shakedown tests of portable microwave systems

August is the month for the start of the ARRL 10GHz Contest. It is open to all participants who have access to or have constructed transceivers for making contacts on 10GHz. The rules are quite simple—communicate with one another and promote activity and experimentation on our microwave bands. Well, there are a few more rules to follow, but the main spirit of the contest is to encourage communications among amateurs and to promote 10GHz microwave communication.

Most amateurs participating in this contest operate either wideband FM or single sideband. Most of the old-timers on this band have migrated to narrowband operation for its superior performance with single sideband operation. Even so, many still take their wideband rigs along just to keep the simple rigs in operation and to make contacts with ever-present new amateurs.

I am sure that in the future (if not in this contest, then in another) there will be amateurs who might attempt high-speed data communications. Some others may use standard video for communications. Art WA6YQH and Ray N6RE could be ready to use their 10GHz facilities for making several contacts using full-scan NTSC video. They have been the video pioneers in our group, making some very important contributions on how to set up systems and methods for video operation on 10GHz.

The beauty of operating on 10GHz is that there is space for all of us to improve our own skills and construction practices. On 10GHz, there are sufficient frequency allocations allowing all these modes of operation.

In our very first years (early 1980s), I operated on wideband FM, as this was the only equipment that was (1) inexpensive and (2) available (inexpensive) at that time. Now, I utilize an improved system that is fully linear in operation. It will pass FM as well as SSB signals equally well. We even tried video operation briefly. My main mode of operation is SSB—distance and weak signal work make this mode of operation the best choice.

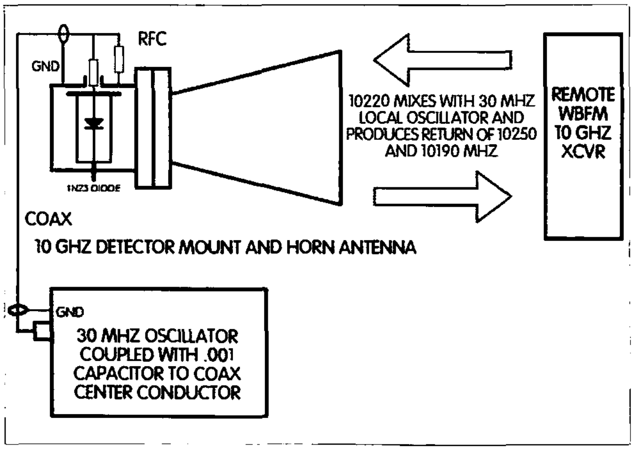


Fig. 1. Basic microwave "boomerang." This device will provide a return signal for a selected band of operation. It is the simplest one that can be constructed for test purposes using wideband FM-type Gunn-diode oscillator receivers/transmitters. Uses local oscillator running at IF frequency of 30MHz injected into waveguide transition and small horn antenna.

When signals are moderate to very strong, we usually switch to narrowband FM. The 5kHz bandpass with FM allows for very crystal clear communications without retuning, as is the case when you work many different stations using SSB. Operation on FM is not unlike using a standard 2m HT, as quality is quite the same.

The ARRL 10GHz Contest is my cup of tea—one that lets us commiserate while participating in something we all enjoy. The annual contest is usually held on the third weekends of August and September. Get a copy of *QST* for contest rules.

Sometimes preparation for the contest is put off till the last moment, and that's what this column is all about. First, to get you thinking about getting in on the fun on 10GHz after you have put together a 10GHz transverter, I want to provide a list of functional tests to ensure that it will work after you transport it to a remote hilltop.

Most things we purchase are expected to operate in almost every environment, whether fixed station or portable/mobile. However, things we home-brew tend to need a little more care, depending on the packaging and construction methods. In this arena, I cast myself into the caldron as I have failed to do, several times, what I am about to tell *you* to do. This is the voice of experience and near failure speaking: If you do not test prior to going to a remote location, you just might not have a functional rig, or at least a very sensitive one, to use. I have found out on more than one occasion that a moment of preparation prior to going to the hilltop will be well-spent time.

What you need to do is to check out your transverter and make sure that all is well. Here the best test is to get several of your buddies together and test all the rigs in your group. You might not have the latest in noise figure or frequency test equipment—this is not needed but nice to have. What you want to find out is how you fare compared to the group of fellow amateurs with whom you expect to communicate.

Is your antenna properly focused, and are your signals being received in similar strength, as well as transmitter power? You're not after an absolute value, but a simple comparison of systems, noting the top performers and finding out what is out of adjustment or not sensitive enough. In general, a full system shakedown performance/repair/adjustment/evaluation on home grounds.

Checking out your rig sounds simple even for a well-equipped home shack, as far as test equipment goes. Remember, even if all seems well, just making the trip to some remote spot with your equipment is the same as placing it on a "shake table." For me, this shake table is the back of my pickup truck. Even though the equipment was carried in boxes, it was still not transported in a "hardened" or shock-resistant state for an arduous trip to a microwave hilltop site.

My transceiver for many years has been a home-constructed system fabricated on the top plate of a 10GHz, 10W TWT amplifier. There are two different DC-to-DC power supplies providing -24 volts, +12 volts, -5 volts, and +24 volts. All are isolated switch mode power supplies allowing a single common ground for all components between input and output of the supplies. There are a microwave brick-type Frequency West oscillator, a mixer, and two 10GHz amplifiers, all connected to a bank of four SPDT microwave relays. In addition, there is a circuit that will detect RF on the IF cable between the transverter and 2m driving radio.

Whatever your system, place it in an environmentally suitable antenna test range in competition with others for some friendly tests. See who has the most sensitive receiver and best power-to-antenna performance. All things are equal when you factor in power output antenna gains expected. By observing

the remote system signal (IF) sensitivity returned in either S-units or so much power as observed on a sensitive RF power meter, you will get some very quick ballpark figures of some really smoking signals and some other performers that should be as good. This test points to a system performance level and may show that some part of the system is not functioning as well as it should be.

The problem could be as simple as changing the feed position on a dish antenna to illuminate it better than what you are getting from where the geometry says the feed should be. Small adjustments can be best made in this type of setting—this is how the pros do it and certify their equipment. Why not take advantage of their antenna range adjustments and apply it ourselves? True, the backyard antenna range is simple, but it's still effective in determining just how well your rig stacks up against others. See **Figs. 2** and **3** for information on how we set up our test range.

The remote transceiver is the most basic unit that can be constructed for the frequency band in question. In our case, the transceiver is constructed for 10GHz operation. It is built with a Frequency West microwave brick-type oscillator operating at 10,224MHz injecting into the LO (local oscillator) port of a microwave coaxial mixer. The mixer output (RF) port is coupled directly to a small waveguide horn antenna that has about 10 to 15dB gain. The horn gain is not important and should be kept low, as we want a weak signal to detect at the far end of the test path.

If signals are too strong, a waveguide or coaxial attenuator can be placed in the connection between the mixer and the antenna. The IF port of the mixer is connected to a long run of coax back to the point of test. In our case, a 300-foot length of RG-59 was used to allow insertion of amplifier pads, power meters, and signal generators to make performance evaluations.

By using a signal generator for the transmitting source, output power can be controlled by the quality attenuator on the generator, sending a measured amount of signal to the remote transverter and seeing how much is required to detect a minimum discernible signal on the test receiver system. The main reason we do not want to use a 2m transceiver for these tests is that the S-meter is limiter-controlled and can give bad information when the signal is in saturation. Using the signal generator with variable power output, it can be set to a calibrated point and referenced to detected sensitivity. These tests are not absolute, but in a practical sense are very good.

It doesn't matter what you choose to use in your system, be

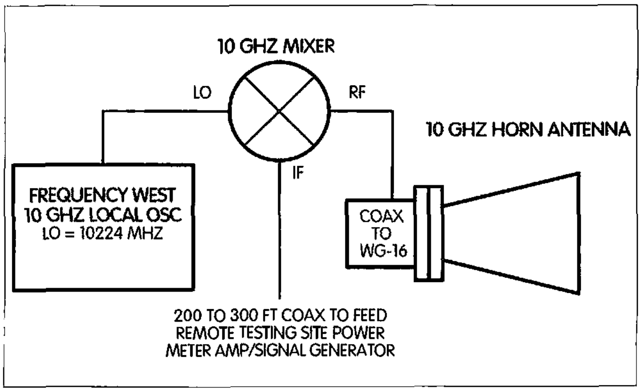


Fig. 2. *Sensitive simple transceiver consisting of local oscillator and mixer fixed to small horn antenna. Operation is linear, so FM, SSB, and video can be run on system. The transceiver is mounted in metal housing to protect it from the elements and provide orientation, horizontal and vertical adjustment for the remote end of the antenna test range. In operation it's a very low power test receiver/transmitter.*

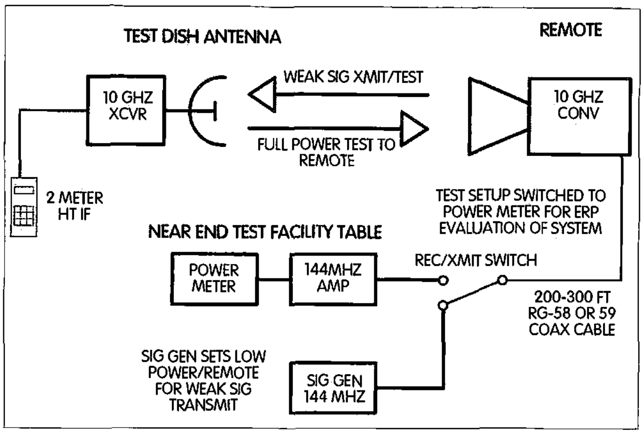


Fig. 3. *Test-range setup using a testing path constructed in Kerry N6IZW's backyard, with a remote flea power transceiver as shown in* ***Fig. 2.*** *The unit is placed at the far end of the backyard—about 200 feet away. The coax at IF frequency of the remote unit (144MHz) is returned to near end of antenna test range for system evaluation. This provides a relative evaluation of system sensitivity and transmitter output power, including evaluation of antenna performance.*

it expensive signal generators and power meters or a 2m handie-talkie. Just be ready to adjust your system, and at minimum with the 2m HT have a variable attenuator or series of coaxial pads (fixed attenuators) to reduce its power output as well as sensitivity on receive.

Run the 2m HT on its lowest power setting. I am assuming 1/4W or so (that's 250 milliwatts), or +24dBm. Remember here that the mixer only needs a maximum of +10dBm for full function.

Adjust your 2m power to conform to these limits at a maximum or else you will just "let the smoke out of" the mixer—and it can't be put back. The loss of a microwave mixer is indeed a sad occurrence. Just be careful and keep power to the mixer in transmit to a low level. When setting up the test range, measure the loss of your long run of coax and include it in the formula you develop for your situation.

Did anyone catch that I stated I used RG-59? Yes, it's not 50Ω coax but 75Ω, and the SWR will not be a large factor in the tests because the coax is so long the effect is quite minimal. Why did I use RG-59? Well, primarily because it was the only coax around that was 300 feet long and in one piece. I did not want to put together a nightmare of splices. Due to the length used, it was not found to be a problem because we needed all the additional loss we could find to make reasonably meaningful sensitivity tests.

How did my rig fare in these test evaluations? Well, I don't expect to take the cake in the receiver sensitivity tests as I still use a pair of MGF-1402 GaAsFET front-end preamplifiers whose noise figure is in the 2 to 3dB range. There will be more sensitive receivers in the test pool. I just haven't had time to take my own advice and improve my receiver noise figure by replacing the MGF preamps with a better GaAsFET at 10GHz. Nonetheless, a transmit power output of 10W and my 30-inch dish should perform on a par with the other systems being evaluated.

Now off to the trials to find out if what I expect to see will be true. Our test is scheduled for an evening meeting of our microwave group, so I hope we get going while I can still take some photos!

And the winner is ...

Well, we had the test-range evaluation, and as I suspected the receiver sensitivity of my 10GHz front end was able to detect a signal as transmitted at -80dB into the test system. The better systems with lower noise figures were able to make minimum

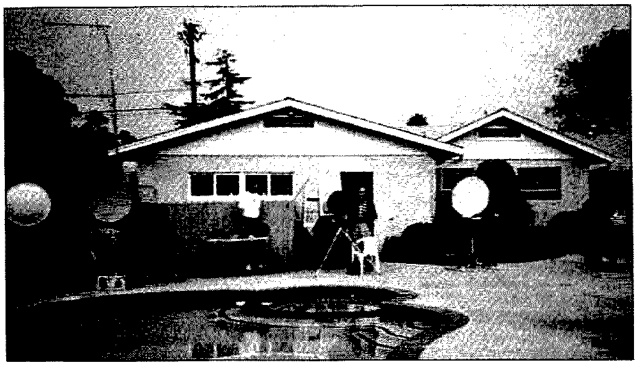


***Photo A.** Photo of N6IZW's backyard, showing rigs to be tested. Left, Ed W6OYJ; at table, Kerry N6IZW; John WB6BKR; author's rig; and Jay KD6PBH. Test-range test performed by Kerry N6IZW at test table.*

discernible signal detections to -85dB.

My system was working well but not top-notch here. The receive results show that I need to improve the signal-to-noise ratio by replacing the first preamp with one of a lower noise figure. As far as transmit goes, we calculated that my system (looking at dish diameter gain and power output of the TWT amplifier at 10W) gave an ERP of 73dB. This compared favorably with Kerry N6IZW's system. Both of our systems use the same type and power TWT amplifier and dish antenna so they should be quite identical in operation.

Next month: the world of coaxial switches. I plan to get into specifics so that you can recognize what makes a good VHF or HF switch and what the differences are. Of course, these switches can be found in surplus as we try to hold down costs. The main thrust will be to show the different types that are available in surplus and what frequencies they are suited for. If you have any questions on this or other topics, please write. *73,* Chuck WB6IGP.

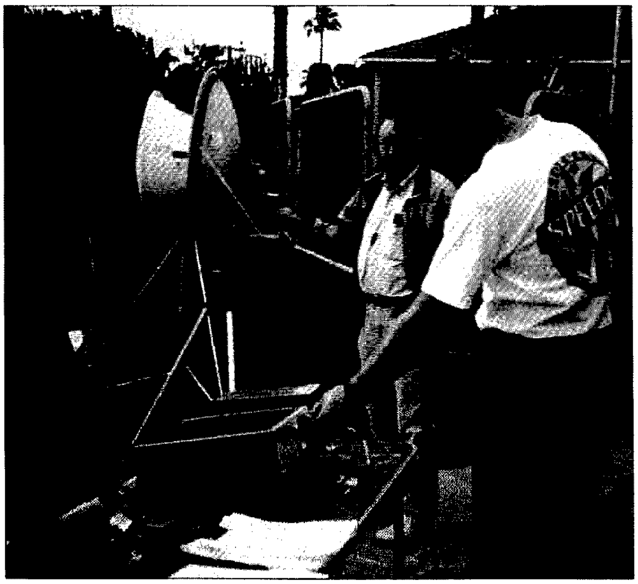


***Photo B.** Close-up of test table and N6IZW checking receiver sensitivity of Ed W6OYJ's 10GHz receiver. What looks like one odd-shaped dish is really two dish setups brought for test (see **Photo A**).*

The Killer Beam

Just how much is "some" assembly?

Hal "Doc" Goodman W3UWH
7 Perkins Road
Eastport ME 04631

I recently came into a small windfall of money. This was the opportunity to finally upgrade my radio station. Using the Internet. I was able to locate an old Heathkit SB200 for a reasonable amount. It arrived. and even though I still have not been able to figure out how to hook up the transceiver to the linear so that they work together, I am able to use it with a manual which turns it from standby to operate. It's clumsy, but it works, and for the time being it will do.

I was also able to locate a 30-foot tower at a reasonable price. Now that we have cable and satellite systems on the island, many people who put up TV towers found that they no longer needed one (even with the best of towers and antennas you were lucky to get more than two or three stations and those erratically—more of the joys of living in rural Maine). A local contractor put the tower up for a very reasonable price. In three yards of cement and bolted to the house in two places. We really do get strong winds out here in the North Atlantic. Again, this being rural Maine, he did a very good job, but it was eight months from the time we agreed on the transaction until he finally did get around to putting it up.

My antenna system, on the other hand, was a semi-disaster. It consisted of an 80m dipole and a 20m dipole hanging from one tree. See the previous section regarding winds.

"All my neighbors were complaining about interference, and there was talk of tar and feathers."

Here, I was determined to do things the "right way." After looking through several amateur radio supply catalogs, I picked up the phone and called one on their 800 number. To protect the guilty, I won't say who I called. Told them what I wanted. "A nice tribander, not too big, with a good strong rotor, new coax, with an SWR/wattmeter to monitor my newly powerful station, and an antenna switch that would ground the antenna when not in use." I added that I did not know much about modern antennas, and asked for recommendations.

After much discussion, I settled on a four-element tribander (here again, no name, to protect the guilty). This being settled, I gave them my credit card number; the card itself melted under the four-figure price. So much for my windfall—but I'm retired, and, unlike the demands of my other hobbies, such as flying airplanes, this was a one-shot investment. It should last me a lifetime—or at least that's how I rationalized it.

Within a week, everything except the actual antenna arrived. A call to the store revealed that this antenna was so wonderful that it was out of stock. The factory was filling back orders and it would take another two or three months till they could ship mine.

Two and a half months later

As you may have guessed, this project has been going on for almost a year. I was getting quite anxious to get my new "super station" on the air. Aside from that, with my old antenna I could only operate late at night. The SWR was so high that all my neighbors on the island were complaining about TV and telephone interference, and there was talk about reviving the old custom of tar and feathers.

The big day finally arrived. As background, let me tell you that the only other beam I'd ever had was an old three-element tribander I'd bought back in the late '50s. It consisted of several

poles and traps that all screwed together very easily and took about two hours from unpacking to up-on-the-roof-and-working. *This* was a horse of a different color. I should have been suspicious when I noticed that the antenna, which measures 16 feet by 32 feet, arrived in a box that measured one foot by one foot by eight feet.

didn't even mention that the expensive length of new coax I'd ordered with connectors already assembled arrived as a coil of coax with two new shiny coax connectors in a small plastic bag taped to the wire.

A month later, putting in two or three hours a day, despite the battle between my arthritic fingers and the slippery goop needed on every fitting and connection, I'd managed to assemble almost half of the antenna. I figured that in another month I'd be ready to move outdoors to put the large pieces together, mount the rotor and thrust bearing, and put up the antenna. Lots of fun in a typical Maine winter.

"Try as hard as I could, I couldn't figure out which way was up!"

Some assembly required

This was not an antenna. It was a 300-piece metal jigsaw puzzle that required a small machine shop and an empty aircraft hangar to assemble. There were poles within poles within tubing within tubing, metal strips, and on and on. When spread out it covered my entire living room, dining room, part of the kitchen and part of the entranceway. For about three months I found myself eating out, having had to relinquish the first floor of my house to this project. There were four large plastic bags full of assorted nuts, bolts, screws, and washers; two large plastic bags full of assorted clamps; a large plastic bag full of assorted plastic caps, slides, plugs and other extraterrestrial-looking pieces; a pot of special goop to put on every nut, bolt, and part that was metal; and a bag full of something as yet still unidentified. There was also a 40-page instruction manual.

Help!

I called the radio supply store to remind them that I'd told them that I am a retired senior citizen with arthritis and they could have at least warned me about what to expect. or even better, have suggested an antenna that didn't require a team of engineers, or that was already partly assembled. Using their best bedside manner, they told me that any idiot should know that all modern antennas are that way and that I was being a crybaby. They did at least agree to take back and give me credit for the expensive balun they'd sold me, seeing as the antenna came with its own built-in one, and they did replace the antenna coax switch with one that actually worked. I

Hello, is the technician in?

In the meantime, despite reading the manual many times, I finally had to admit defeat and call the manufacturer, who of course does not have an 800 number. The manual emphasized, several times, that the vacuum holes inside the capacitor sleeves had to be facing up, but try as hard as I could, I couldn't figure out which way was up! The manufacturer's representative was more sympathetic than the store had been, and did admit that there really was no way to tell, using the manual, which way was up. She explained that "up" was off the horizontal axis, with each opposite element end being the mirror image of the other, and each separate element end being the obverse of the preceding one. I asked, "If the antenna were lying on the ground, would the element ends be lying flat or up and down?" She said, "Flat." Amen.

Persistence pays off!

It took me about two months to get all the parts put together into nine large components. The weather forecast called for several days of good weather, so I took the nine components out into the back yard and, using two large wooden picnic tables, completed the final assembly. The measuring and final assembly went much more quickly and easily than I had anticipated.

With the help of a large "cherry picker" and two agile young men, the completed antenna was lifted up and mounted atop the 30-foot tower. I must say that I was really looking forward with great anticipation to that weekend of ham operating.

Running low power and then high power, I found that I had a flat 1 to 1 SWR on 20m, a 1.1 to 1 on 10m (1.3 to 1 above 29.5), and a 1.3 to 1 on 15m. In addition, rotating the antenna made a very significant difference in signal strength when both transmitting and receiving. I was hearing stations that I had never heard before.

Over the next three days, on 20m I worked six Japanese, two New Zealanders, an Australian, literally dozens of Europeans, four Israelis, a Kuwaiti, several Russians (including a Siberian station), the South Pole, Hawaii, Alaska, etc., etc. And in almost every case, they reported that I was the loudest signal on the band!

Well, let me tell you, after almost 50 years of being one of the many stations in the pileup, just getting more and more frustrated, it felt really great to be the "800-pound gorilla." The very worst I did was to be the second or third station recognized in huge pileups—and this was from stations that before the new antenna I could not even hear at all.

With my almost ideal location, overlooking the Atlantic Ocean, it has only gotten better since then. So I would say to my fellow hams who are also old enough to remember the smell of ozone from their rotary spark gaps, there really is something to this new technology of trapless beams. Despite all the effort and frustrations involved in getting the antenna up, I would do it again. If you could have been in the room with me when I got reports from stateside and South American stations telling me I was pinning their S-meters, or from some rare DX telling me I was 40 over nine, you'd have thought from the look on my face that I was a five-year-old getting a pony for Christmas.

My new antenna has renewed the excitement and brought back the joy I first experienced so many years ago. If ham radio is getting old or boring, I recommend that you, too, consider modernizing or upgrading your station, despite all the effort involved—or perhaps *because* of it.

Music from the Past

A distinctive fist brings back memories of a revered silent key.

Guy Slaughter K9AZG
753 W. Elizabeth Drive
Crown Point IN 46307

I heard him on the low end of 20 the other night, more than a decade after his death, and it made me wonder whether other people ever hear silent keys they've known and loved.

Mine was named John Miller. His call was W9PBS. He was a sightless ham who inspired a lot of other hams and non-hams, sightless and sighted, to do whatever it was they had to do with pride and with dedication, in ham radio as in life, and to do it *better*.

"Don't ask a good op how to operate or a good man how to live," he would say. "Listen. Pay attention. Then emulate!"

What I heard the other night was his fist—different, personalized, unmistakable—his! He'd patterned it early on, he once told me, after that of a Merchant Marine amateur aboard a banana boat somewhere in the Caribbean whom he'd worked as a brand-new ham in the 1930s.

"That op's CW cadence," John said, "was distinctive enough so you could copy him through fourteen other guys, all zero heat."

I can't vouch for the accuracy of that comment, but I can swear the description fitted John. He held his venerable Vibroplex's dashes a heartbeat too long for its dotting rhythm at any setting of its speed-weights. Once heard, you'd recognize him anywhere, rag-chewing or in a pileup, by those slightly heavy dahs interspersing the perfectly timed dits. Inexplicably, his dah-accenting fist didn't change at all when, in later years, he switched to a paddle and a keyer.

On AM and then on sideband, John's phonetic moniker for his suffix, "Peanut Butter Sandwich," was heard only rarely, during infrequent lapses from his beloved CW into what he disdained as "mouth mode."

Before I was licensed myself, I found this curious. Surely, I thought, talking with other people across the void must be more fun than just exchanging signals with them in some primitive dot-dash jargon. But John preached otherwise.

"Talk," he would inform me, "is chatter. Morse is music." It took me years to learn that he was right.

As a neighbor, friend, and electronics aficionado, I was for half a lifetime privileged to be among those called on by John for help in some of the small things he couldn't manage himself: finding and fixing equipment bugs; erecting antennas (wire dipoles and slopers in trees early on: beams and rotators atop towers in later years); programming 2m gear for local repeaters; keeping the HF rig properly dipped in his favorite bailiwick, the low end of 20.

"That's where the DX lurks," he explained to me the first time he asked me to check his final for resonance at 14.030, adding the admonition, "Be quick and be careful." His transmitter then was a home-brewed rack-and-panel affair with a personality of its own. Its power transformer hummed the basso background for "Old Man River," while its 866s flashed their intense blue glow in the staccato cadence of the rig's keying. Its final was a heavy-duty triode famous for its unforgiving ways: Operate it very far off resonance for more than a very few milliseconds and you'd be shopping for a replacement.

"Short key-downs and long key-ups," John would exhort me. "And dip it at fourteen oh thirty so I can zip from fourteen oh one to fourteen oh fifty without blowing the final. That's where the DX pops up."

And when it did, so did he. Nights and weekends, from the late 1930s to the late 1980s, the war years excepted, few DX stations could bounce a rare prefix into northwest Indiana anywhere between 14 and 14.050 megacycles (then; it's become megahertz only relatively recently) without encountering calls from and QSOs with a blind ham whose dash lengths characterized a distinctive fist and whose attitude characterized a noble person.

Days, John worked as a proud entrepreneur, operating the concession stand in the county-seat courthouse. He made the coffee, sold the goodies and the cigarettes, maintained the inventory, kept the books. He greeted hundreds of patrons and friends daily, recognizing most by their voices and many by their footsteps. He kept track of his money by stowing ten-dollar bills in one pocket; singles, fives, and twenties in others.

Afternoons, when the courthouse closed, he and the then-current version of perhaps the dozen or so beloved and devoted guide dogs he went through in his adult lifetime would hike the ten blocks home to XYL Fran and harmonic Paul Albert in all but the most inclement weather. He took a cab only when snow

or ice made walking hazardous. On rare occasions he might accept a ride from a friend, but, "Only if you're headed my way!"

Evenings, John would "pay my dues to the community," attending Lions Club meetings, playing Elmer to potential hams, encouraging new ones to "emulate," welcoming a steady stream of visitors to his kitchen and/or ham shack with steaming mugs of the muscular black coffee he called "sludge."

Until the last decade of his lifetime, it bothered John mightily—though he'd deny it if you mentioned it—that he needed tune-up assistance from friends. The only tip-off was the regularity with which he'd mumble, "Looks like somebody'd invent a talking milliammeter," while one of us was dipping and tweaking his rig. Then he'd ask, "What's she read at resonance?"

"One forty," he'd be told.

"Load her up another sixty. I want two hundred mils on the nose. Looks like somebody'd invent a talking milliammeter."

Finally, somebody did. From an article in this magazine, I built for John a solid-state audio oscillator whose tone varied with the amount of plate current drawn by the finals of a rig coupled to it. Once it was hooked up and he was "shown" it (given ten minutes to inspect it with his fingers), it took roughly thirteen seconds of instruction for John to master its use. It may not have been the very best day of his whole life, that first-time tune-up of his rig, alone, unaided, all by himself. But it came close!

With the advent of TV and its accompanying TVI, John reluctantly junked his home-brewed, open-frame, rack-and-panel transmitter, and graduated to commercial TVI-shielded transceiver usage. His first was a Yaesu with a pair of the then brand-new-and-wondrous TV horizontal-oscillator tubes in the final. He loved it. He worked the world with it (and so did I, visiting him, by then long-since licensed myself) until it died and none of us local "experts" could revive it.

Then he swapped it in on a Kenwood 520 with extra-tight IF filters (the kind that are common today), which remained the joy of his life for his remaining years. The last I knew, that rig still was in use by a former neighbor of John's, then respectably known as W9PUB, who moved it from warm-and-sunny Indiana to the cold-and-snowy regions of Wyoming, where he's been hiding out ever since behind a new and strange two-letter 7th District call I never can remember. But the transfer of ownership came only after John Miller became a silent key.

For a long while I grieved, mourning him and the disappearance from the low end of 20 of the distinctive fist of W9PBS, the old Peanut Butter Sandwich, the man to whom "Emulate!" was advice and Morse was music. So did many others. We took comfort from the words of the preacher delivering his funeral eulogy, "Now John can see!" We consoled ourselves that he was working better DX across wider voids from a better QTH with a cosmic-state rig feeding a Universal antenna. Thus, gradually, the passage of time worked its inexorable magic of healing and of forgetting.

But then, the other night, I heard him on the low end of 20!

I was reading the mail, tuning idly across the band, catching a word here, a phrase there, absently noting which call areas were coming in, as a fellow will do on a dull evening. And suddenly, there it was! This weak signal, almost into the mud yet readable through stronger ones because of its distinctive cadence, was wrapping up a QSO.

I didn't catch the call, but there was no mistaking the fist. The way the dahs were a mite too long for the dits fingerprinted the op for me. There could be no doubt. Whatever the signature, it was—it had to be—John, the late W9PBS, the old Peanut Butter Sandwich. And then a final bar of music from that distinctive, unmistakable fist, singing "gl es sk es cl," left me listening to static crashes, cosmic noise, the pounding of my own pulse.

That's when I found myself wondering whether other people sometimes hear their own dear-departed buddies making distinctive and unmistakable Morse music in a favored section of a favorite band.

I'm pretty sure they do ... 73

Number 85 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153
[ajr@ari.net.]

Well, this month I find I have been soundly blasted by the readership. Why? Because there are apparently several programs out there that use a Soundblaster™ card, or compatible, to decode radioteletype. This month, we will have a look at two of them, along with one other, non-Soundblaster, program for good measure.

Brent Stuart ZL4TX dropped me a note tipping me off about an application called FTV, written by Brian E. Cauchi 9H1JS, in Malta. This program decodes quite a variety of digital modes. It is available via Brian's home page: [http://www.geocities.com/SiliconValley/2504]. FTV is currently in Release 0.98g, and handles RTTY, FAX, SSTV, and CW using a Soundblaster interface card. As the author says, FTV brings innovative digital signal processing and analysis techniques to your multimedia PC. It can be used to receive images from weather satellites and terrestrial facsimile stations, text transmissions from radio telex services, as well as amateur radio FAX, SSTV and RTTY signals. It can also transmit amateur radio FAX and SSTV (slow scan television). No external hardware, other than a radio, is required, as all the necessary signal processing is implemented in the software.

The main strength of FTV lies in the approach used for processing the incoming signal. During reception, the demodulator waveform is stored in memory, which allows recovery of incorrectly set parameters, such as FAX lpm, SSTV modes, and RTTY baud rates, on the fly. Watch jumbled pictures take form, while the incoming signal is processed and displayed in real time. Automatic mode recognition is provided for FAX, SSTV, RTTY and CW modes. And again, no additional hardware is required.

Minimum system requirements include an 80386 CPU, Soundblaster-compatible sound card, 256K of expanded memory (preferably 1024K or more), and SuperVGA graphics card with VESA support (at least 640 x 480, 256 colors).

An unregistered trial version of the software is available at the above Web site. I will be adding it to the RTTY Loop Software Collection as well for those without Web access. See below for details on this assortment of RTTY software.

Another program Brent mentioned is RADIORAFT by Francois Guillot F6FLT. This program listens to the incoming signal and scans it, similarly to the PK-232, to decide for itself just what you are listening to, displaying the data accordingly. It is available on the author's page at: [http://ourworld.compuserve.com/homepages/F6FLT]. RADIORAFT is advertised as decoding modes including ARQ-E, RUM-FEC, Baudot, ASCII 7,8, Sitor-A and B (Tor-arq/fec), ARQ-6, SI-ARQ, SWED-ARQ, ARQ-M (2 and 4), ARQ-E3, ARQ-N, POL-ARQ, FEC-A, HNG-FEC, CIS11, SI-FEC, Autospec, Spread, Packet, and Morse. With automatic detection of modes, speeds and shift, an included frequency meter/baud meter, and signal frequency tracking, this program is a powerful addition to the RTTY amateur library.

Requirements for this program are a PC with a simple interface, such as a plain terminal unit, or Hamcomm or Baycom type interface. This is *not* a Soundblaster-type program.

Once again, this program can be downloaded from the above Web site. Since CompuServe sites can be slow, though, the author provides several worldwide mirrors on the site to enhance access, a nice touch. Of course, this program will be in the collection, as well.

Yet another program surfaced by way of Bob Lewis AA4PB, who told me about Brian Beezley K6STI, writing a program called RITTY which also runs on a Soundblaster card. The program is described in some detail at: [http://www.ping.be/ON9CNC/FEB97.HTM].

By the way, notice the uppercase letters on this address. Be aware that Unix systems are case sensitive, and that if you type this address in lowercase letters you probably won't connect! I know I didn't until I found the site via a search.

Anyway, Brian tells me that RITTY 2.0 is a DSP data-communications system that now includes PACTOR. RITTY provides state-of-the-art RTTY and PACTOR transmission and reception using digital signal processing. RITTY is software that runs in your PC and uses your sound card for analog I/O. No specialized hardware is required.

RITTY's RTTY demodulator uses a limiterless front end and optimal channel filters with the SIN(x)/x matched-filter response that maximizes receive sensitivity. The filters automatically tune to the incoming mark and space tone frequencies for effortless copy. A sophisticated automatic threshold correction algorithm maximizes text recovery during selective fades. A special wideband detector minimizes polar flutter, while a narrow input bandpass filter fights QRM. An effective squelch suppresses noise print. Special data-presentation modes allow text recovery and signal analysis under difficult conditions. RITTY can act as a modem for the RTTY by WF1B contest-logging program. RITTY's licensed PACTOR implementation features a sharp input BPF, concurrent 100- and 200-baud optimal SIN(x)/x channel filters, gated, synchronous ATC for selective fading, 21-bit memory-ARQ with optimal combinatorial weighting coefficient, single-bit error correction without ARQ, recognition of noisy control signals, fast callsign detection for quick linking, and tolerance for partially compatible, unlicensed PACTOR implementations. RITTY provides remarkably fast and robust text throughput under difficult conditions.

RITTY has an FFT-based spectral tuning indicator that's easier to use than a scope and more informative. A demodulated-waveform display provides detailed signal and propagation analysis. RITTY features both AFSK and FSK transmit output, adjustable mark/space frequencies, selectable Baudot punctuation, and fine control of protocol timing and detail. RITTY automatically records all received text to a file and can transmit text files.

The program requires a 486DX/33 minimum, math coprocessor, and VGA display. Implementation of RTTY modes is with most eight-bit sound cards, while PACTOR requires a 16-bit Creative Labs Soundblaster card.

This is a commercial program, but a trial version is available at the Web site, [http://www.megalink.net/~n1rct/], which is maintained by Dick Stevens N1RCT and has a wealth of RTTY software information available on this and other programs.

The RITTY Program, version 2.06, is $150, and is available from Brian Beezley. Of course, the download version is in the collection, as well!

My sincere thanks to both these gentlemen for bringing these programs to my attention. Any others out there in the wings?

Now, above I mentioned the RTTY Loop Software Collection. This is a collection of some seventeen disks of software of interest to RTTYers, including both RTTY and non-RTTY programs, as well as some computer utilities. You can see a full list of the programs, as well as have the opportunity to download some of them, on the RTTY Loop home page at: [http://www2.ari.net/ajr/rtty/]. Or, if you cannot connect to the Web online, you can send me a request via E-mail at [ajr@ari.net] and I'll E-mail you back the list. Or, if you can't even do that, send a self-addressed stamped envelope to me at the address above and I'll return the list to you on paper! The information supplied will fill you in on all the details of obtaining copies of the programs for your own use.

I still have some other items you have sent me to use, but I always can use more! You can

Number 86 on your Feedback card

Hams with Class

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Multi-cultural projects

Several weeks into the spring semester with my new ham radio classes, many of the students seemed to be especially fascinated with the idea of being able to speak with people from different countries. I usually get about 400 students in my 13 radio classes; each term there is a different "chemistry" to the classes.

"... remember that children who are busy chasing DX aren't being chased by the police!"

There have been times when most of the children gravitated to VHF and UHF exclusively, and other times when they only wanted to get involved with ATV, packet or CW.

This term the 6th, 7th, and 8th graders were eager to get started with different DX projects. Several of my former students who were still in the school brought in QSL cards from contacts they had made on their own 10m rigs at home. My students always enjoy listening to their peers speak about what fun they're having in the hobby. The licensed students enjoy sharing their expertise with the other kids.

I often invite local hams who are active DXers to visit my classes. I encourage them to bring QSL cards from interesting places to display for the children. They always bring lots of great stories to relate about exciting contacts they've made.

Through the years several of our unusual contacts have been videotaped by children in the class. I've learned the value of showing footage of other kids having fun and doing exciting things in my classroom. It's kind of like showing "coming attractions" of all the good stuff that's yet to come.

One afternoon when we had several boxes of QSL cards to go through, we decided to organize them by country and to assign teams to each country who would report back to us with more information about the culture and geography of that country. Before long we were involved with the ESL (English as a second language) teacher and with the foreign language department fair. Parents were sending in dishes of foods from their native countries along with samples of clothing and other articles indigenous to those areas of the world.

One of the best projects the children came up with was a multi-cultural quilt made of construction paper. Every time a radio contact was made with a different region of the United States or with a foreign country, a child would make a square patch with tempera paints to include a scene or symbol of that area. When the patchwork "quilt" was completed, we were all so delighted with it that we had it hung up in the school auditorium for visitors to see as well.

A fun toy that one of the teams made when they presented their reports on Mexico was the *bolero* toy. Several of my students received personal family photos from the hams they had spoken to. This personal touch led them to research things of interest to young people in that country. The bolero toy was a big hit in class. The game itself requires simple hand-eye coordination. The materials needed to make it are: a toilet tissue cardboard or paper towel tube cut in half, an 18-inch-long piece of yarn, an empty thread spool, tempera paints and brush, and a hole puncher.

First, the children painted the tube in bright colors and designs, and let it dry. Next the wooden spools were painted and left to dry. A hole was punched in the paper tube near the top. The student then ties one end of the yarn to the tube and the other end through the spool. The object of the game is to get the spool into the tube while holding the tube in one hand. Needless to say, we all had a good time with this one. Later on, the toys were packaged and brought over to a local community center where they were distributed to appropriate children's organizations.

When my students speak with other children or any other ham anywhere outside of our area they like to find out the things that are different about them. They are also starting to appreciate the fact that all people have lots in common with each other—especially things that appeal to children. Most students, wherever they are from, are concerned about report cards, grades and tests. It's an enlightening experience listening to children talking to youngsters from other places and sharing so many of the same concerns and fears about the world today. As adults, maybe we should be listening more to what the young people are saying.

Any teacher with the capabilities for DXing in a classroom will have a myriad of activities they can do with their students, encompassing all areas of the school's curricula: social studies, science, math, language arts, geography, foreign language, and even crafts. Have fun; and remember that children who are busy chasing DX aren't being chased by the police! 73

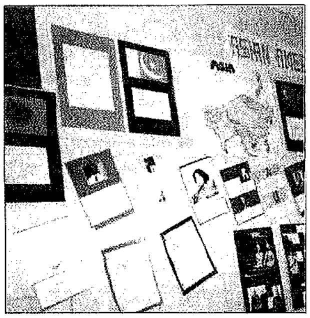


Photo B. An international cultural hall was set up outside our room as a continuation of the project so more people could share in the DX fun.

Photo A. Exchanging cultural objects is a favorite spin-off project after a DX contact.

RTTY LOOP *from page 85*

E-mail me [ajr@ari.net], or AOL users can use [Marc WA3AJR], while CompuServe users can send mail to [Leavey] on the CompuServe system. If push comes to shove, scribble your comments or questions down and send them to the P.O. Box address above. See you next month here at RTTY Loop! 73

PROPAGATION

Jim Gray W1XU
210 E Chateau
Payson AZ 85541

As this forecast is being prepared (early May), solar flux values continue in the low 70s with little likelihood of an immediate improvement. The usual high July-August HF signal absorption levels will combine with low flux values to depress HF propagation this month. Poorest days (P) are likely to surround the 1st, 9th, 10th, and 20th when an upset-to-active magnetic field and accompanying ionospheric disturbances are most likely. You can also expect other geological upsets and violence near these days. The best (G) days to search for DX are likely to be the 5th, 13th, 17th, 23rd and 27th–30th, while the remainder will be only Fair (F) or trending, as shown on the calendar. The onset of Cycle 23 appears to be sluggish at best, with only a few signs of improved propagation conditions. The only advice we can offer is to practice patience, listen a lot, and hope for improvement this fall or next spring.

AUGUST 1997						
SUN	MON	TUE	WED	THU	FRI	SAT
					1 P	2 P-F
3 F	4 F-G	5 G	6 G-F	7 F	8 F-P	9 P
10 P	11 P-F	12 F-G	13 G	14 G-F	15 F	16 F-G
17 G	18 G-F	19 F-P	20 P	21 P-F	22 F-G	23 G
24 G-F	25 F	26 F-G	27 G	28 G	29 G	30 G-F
31 F						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						20	20					
ARGENTINA	20	20	20	40			20	20	15	15	15	15
AUSTRALIA		20	20	20	40	40	20					
CANAL ZONE	15	40	40	40	40	40		15	15	15	10	10
ENGLAND			40	40			20	20	20	20	20	20
HAWAII			20		40		20					
INDIA												
JAPAN						20	20					
MEXICO	15	40	40	40	40	40		15	15	15	10	10
PHILIPPINES							20					
PUERTO RICO	15	40	40	40	40	40		15	15	15	10	10
RUSSIA (C.I.S.)							20	20		20		
SOUTH AFRICA			40	40		20	20				20	
WEST COAST	20	40	40	40	40	40						20

CENTRAL UNITED STATES TO:

ALASKA		20	20					20	20			
ARGENTINA	15	20	20	40			20	20		15	15	15
AUSTRALIA	15	20	20	20	40	40		20			20	
CANAL ZONE	15	20	20	20	40	40	20	20	15	15	15	10
ENGLAND	20	40					20	20		20	20	20
HAWAII	15	15	20	20	20	40	20	20				
INDIA												
JAPAN		20	20					20	20			
MEXICO	15	20	20	20	40	40	20	20	15	15	15	10
PHILIPPINES		20	20				20	20				
PUERTO RICO	15	20	20	20	40	40	20	20	15	15	15	10
RUSSIA (C.I.S.)								20			20	
SOUTH AFRICA							20				20	20

WESTERN UNITED STATES TO:

ALASKA		20	20						20			
ARGENTINA	15	20	20	40	40			20	20		15	15
AUSTRALIA		20	20	20	20	40	40		20		15	15
CANAL ZONE	15	15	20	20	40	40		20	20	15	15	15
ENGLAND	20							20	20			20
HAWAII	20	15	15	20	20	20	40	40	20		20	20
INDIA				20					20			
JAPAN		20	20						20			
MEXICO	15	15	20	20	40	40		20	20	15	15	15
PHILIPPINES				20					20			
PUERTO RICO	15	15	20	20	40	40		20	20	15	15	15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA			40						20			
EAST COAST	20	40	40	40	40	40						20

Band-by-band propagation this month:

10–12 meters

Occasional intense sporadic-E propagation may provide openings to 2,000 miles or more, while frequent short-skip openings out to 1,000 miles or so can occur on Good (G) days.

15–17 meters

Frequent short-skip openings to 1,500 miles and occasional long-skip openings on north-south paths across the equator are expected on Good (G) days.

20 meters

DX to all parts of the world can be expected on this band from sunrise to sunset on Good (G) days, with peak conditions usually occurring a few hours after sunrise, and again in the late afternoon. Short skip to 2,000 miles or so may be expected as well.

30–40 meters

Consistent nighttime DX to all parts of the world is expected from sunset to sunrise, with the possible exception of poor reception due to high static levels during thunderstorm activity. Short-skip openings averaging 500 miles during the daytime and 1,500 miles at night are anticipated.

80–160 meters

Nighttime DX on 80 and 160 can be fair this month, with the exception of high noise levels on both bands from thunderstorms. Daytime short skip of a few hundred miles is possible on 80 but not on 160. Short-skip propagation is expected at night on each band, and ought to be fair out to perhaps 1,400 miles or so, but limited by QRN. 73

NEVER SAY DIE
Continued from page 77

I can skip through the commercials.

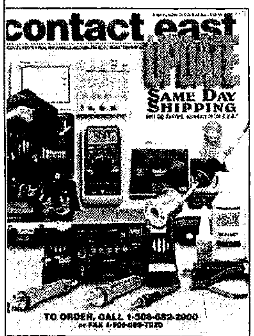
Get On Your Duff

... and exercise your word processor. Fame and fortune can be yours ... just whup up an article for us. Maybe some gadget you've built? A better antenna? Or perhaps you've bought a new piece of equipment that is so great that you think others really should know about it. Well, tell 'em! And don't forget to send along a disk copy of the text so I don't have to sit here and retype it.

Has amateur radio brought you any adventures? It has me, and I write about 'em so others can share in the fun I've had. If you haven't had any adventures, get yourself in gear! Our hobby has a world of adventure open for you. I'll never forget my Oscar contact with Moscow during a 20-second window. Or working 2m aurora. Or working six states on 10 GHz from a local mountain. Or working a bunch of ZS ops while in a balloon while cruising over the South African veldt. Or diving for dropped antenna elements in the shark-infested water at Navassa.

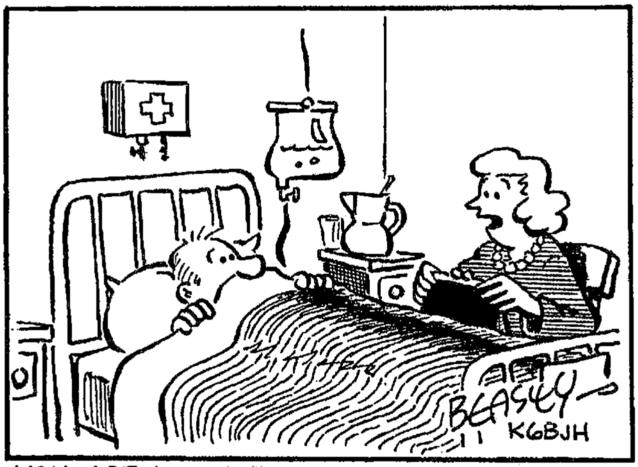
Now get busy and share the fun you've had with the rest of us.

MORE...NEW PRODUCTS



1997 Catalog Update

Contact East's got another one—a 64-page catalog update packed with stuff you need. *Sure* you do. You *deserve* it—so get your free copy from Contact East, Inc., 335 Willow Street, North Andover MA 01845; call (508) 682-2000 or FAX (508) 688-7829.



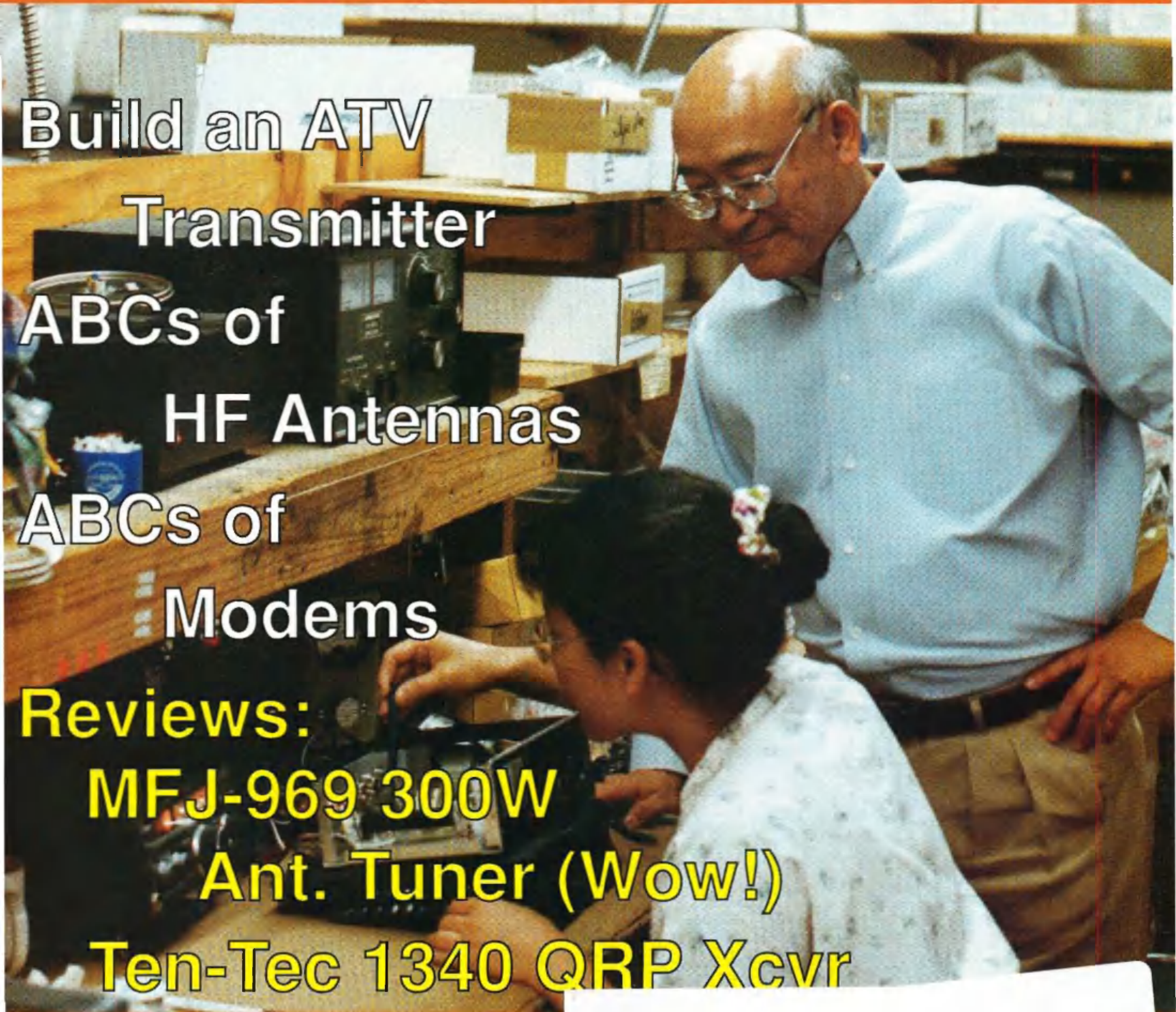
YOU GOT A PACKET MESSAGE LAST NIGHT, BUT YOU DON'T HAVE TO ANSWER IT--YOUR HAM SHACK BURNED DOWN THIS MORNING

Including Ham Radio Fun!

SEPTEMBER 1997
ISSUE #444
USA $3.95
CANADA $4.95

International Edition

73® Amateur Radio Today



75th Birthday

Business Office
Editorial - Advertising - Circulation
Feedback - Product Reviews
73 Amateur Radio Today Magazine
70 Route 202N
Peterborough NH 03458-1107
603-924-0058
Fax: 603-924-8613

Reprints: $3 per article
Back issues: $5 each

Printed in the USA by
Quad Graphics

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article [IBM (ok) or Mac (preferred) formats], carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

SEPTEMBER 1997
ISSUE #444

73® Amateur Radio Today

Including Ham Radio Fun!

TABLE OF CONTENTS

FEATURES

REVIEWS

HAM RADIO FUN SECTION

DEPARTMENTS

On the cover: Yue-Er Lian KB5JNY, antenna tuner technician (left), and Martin F. Jue K5FLU, president and founder of MFJ Enterprises, Inc., examine a new MFJ-949E antenna tuner. The MFJ-949E covers 1.8–30 MHz and handles 300 watts. Congratulations to MFJ who will celebrate their 25-year anniversary next month.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The entire contents ©1997 by 73 Magazine. No part of this publication may be reproduced without written permission of the publisher, which is not all that difficult to get. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Happy Birthday *73*!

Next month we'll be starting our 38th year! It's been a fun and exciting 37 years. Wow, the adventures I've had as a result of amateur radio! Which is why I keep being such a pest, trying to get you off the couch and enjoying the fun that's out there, if only you'll make the effort. The slow-scan guys are having so much fun, it would be made illegal if the government suspected. The packet guys need some goosing if they're going to keep up with the Internet. So get in there and goose 'em. Let's see some blindingly-fast HF packet developed. They're putting video and hi-fi audio on the Web, so how long is it going to take you to catch up?

Medical Update

A couple years or so ago I explained about the Australian doctor who had discovered that peptic ulcers are caused by bacteria, not stress. *Helicobactor Pylori*. Dr. Barry Marshall fought the medical establishment for 10 years before he made any headway in getting what he'd discovered recognized. I think it was an article in *The New Yorker* that finally broke the establishment's resistance.

The June 9th issue of *Fortune* had a seven-page article on the subject. It points out that even today, 13 years after Marshall made his discovery, most doctors are still treating ulcers the same old way, mainly with Zantac™ and Tagamet™, which enjoy over $5 billion in sales per year. Tagamet™ is the best-selling drug on earth. However, as usual, these drugs treat the symptoms, not the infection, so when a patient stops taking them he's right back to the doctor for a new prescription. It's a great moneymaker for the industry, with ulcer patients making up about 25% of most practices. And now and then the doctor does an endoscopy, for which he charges $1,000, so he can take a look-see in the stomach. 10% of Americans have ulcers, and it's almost 100% in some countries.

Perhaps you can understand why the medical industry has been so amazingly resistant to curing ulcers, which have been considered an annuity disease by doctors.

This may also help you understand why the Albert Einstein College of Medicine is keeping their simple electronic cure for AIDS, herpes, lupus, Lyme Disease, syphilis, etc., quiet. I'm hoping that I can get the word out enough about the Bioelectrifier so that it can't be stopped. But now perhaps you can understand why the industry has less than zero interest in testing the unit or in getting it accepted by the FDA.

The FDA, by the way, has no interest at all in whether something cures an illness or not; they are in business to enforce the laws which say that only drugs and procedures which have been accepted by the FDA are permitted to be used. If you have the slightest doubt about this you need to read some of the books in my guide. Read about Royal Raymond Rife, Gaston Naessens, Wilhelm Reich, and a bunch of other doctors who were persecuted, and often imprisoned.

Go to the library and read the *Fortune* article and see if you don't get a little angry. If you have any kind of an illness you need to do some homework and not put your life blindly in the hands of your doctor, depending totally on his expertise and honesty. Indeed, as a result of my radio interviews I've gotten letters from a distressing number of doctors the FDA has put in prison for using non-FDA-accepted procedures.

By the way, the *Fortune* article points out that most doctors don't bother to read the medical magazines or go to conferences. They depend mostly on the salesmen from the drug companies for their information on what's new.

I've mentioned in a recent editorial about the TV exposé on the cure for epilepsy which was discovered at the Johns Hopkins Hospital several years ago and then kept quiet. And Dr. Wallach says in his book that diabetes can easily be cured, and he explains how.

Our Oblate Spheroid

Along about in the second grade my geography teacher, Miss Camel, explained that the world is not a sphere, but an oblate spheroid. Naturally, I believed her. Now comes known troublemaker René, who says that's baloney. Of course, when I pointed out to Miss Camel that the coasts of Africa and South America were remarkably similar, making it look as if they must have been connected sometime, she said that was just a coincidence.

René was struck by the anomaly of the remains of thousands of tropical animals being found in the Arctic. You see, even if the Earth were warm enough for them to live there, there would not be enough sunlight all year around for the trees these animals needed for food to grow. This suggests that either the Earth's crust or the Earth itself shifted. Well, something had to shift, and very suddenly, too.

René points out that no matter how carefully we map the Earth the adjacent maps don't quite fit. He suggests that if the Earth were a sphere and had no equatorial bulge, the maps would then fit. So he's interested in getting together with someone to measure the angles of the stars rising from the horizon to pin down how much bulge, if any, there really is.

Scientists have no good explanation for the huge piles of animal bones in some places in the Arctic which testify to a sudden mass extinction. Nor for mammoths frozen in the ice, some still standing, with tropical plants in their stomachs. So maybe there's something to the idea that the Earth may be a sphere and occasionally change its axis. Velikovsky may not have been that far off. And, who knows? Atlantis may be buried under a couple miles of ice at what is now the South Pole.

René made a very good case for our being flim-flammed on the Moon landings (no one who has read his *NASA Mooned America* book has refuted his arguments). Ditto his scientific blasphemy in his *The Last Skeptic of Science*.

René is also exercised over the Fed and our money supply. But that's a mess you really don't want to know about. That might get even you upset, and we sure don't want *that*.

René suggests that the off-center buildup of ice at the poles could cause the Earth to suddenly change its axis, causing warmer regions to move to the new poles. Robert Felix, in his book, *Not By Fire, But By Ice*, points out that ice cores in Greenland show that ice buildups happened in days, not eons, and that they are consistent with the magnetic pole reversals.

Just think what a sudden shift of the Earth's magnetic field might do to every data tape or disk in the world! A magnetic pulse of one gauss sweeping through all magnetic media might well destroy our data disks, including our hard drives. No, it wouldn't bother CD-ROMs.

So René may be right in his *Skeptic* book after all when he says there never has been an ice age, only a shifting of the poles.

A fast change in the Earth's poles would not only flash-freeze previously warm regions, as has happened before, but would undoubtedly trigger enormous worldwide floods. Like the one Noah did so well with—and is also reported in virtually every ancient record we have.

Pole shifts like this have apparently happened frequently in geologic history and another is due any day now, so keep your seat belts fastened when you drive, and it wouldn't hurt to keep a parka and some scuba gear handy.

Basics

In my editorial a few months ago I asked for recommendations of any currently available books on the fundamentals of electricity. A note from Mark WX3O suggests you encourage newcomers to the hobby to get *Getting Started in Electronics* by Forrest Mims, which is available for $6 from Radio Shack™. Bargain. Mark says he's been using it with home-schoolers for seven years with excellent results. He also recommends the "First Steps in Electronics" kit.

Antiques

An article by Ed Mitchell KF7VY in the SJRA *Harmonics* almost got me to thinking. It had to do with the decline of amateur radio, citing our lack of license growth and the ARRL's deficit last year.

He pointed out that CW is 100 years old, SSB is 40 years old, and NBFM is 50 years old. SSTV is also about 40 years old and our packet protocols are still hung up in the computer dark ages. He feels the FCC restrictions on our experimenting and pioneering are the main problem. Well, they're certainly a big problem, but the lack of incoming youngsters is even more serious, I feel. All of our major breakthroughs in the past have been done by youngsters. I was 25 in 1948 when I helped pioneer NBFM by building a reactance modulator into my BC-459 exciter. I was 36 in 1959 when I flew around the world operating SSB from a plane.

The FCC's restrictions on experimenting have long been a complaint of mine. When I got involved with RTTY in 1949 (almost 50 years ago) we were restricted to 2m and up (plus 11m). It was a long fight to get them to allow RTTY on the HF bands, with the ARRL fighting every inch of the way to prevent it, but we finally made it. Even so, we had to send our calls using CW so the FCC monitoring stations, which could not copy RTTY, could identify us.

We should be free to experiment with high speed ASCII, spread spectrum, and anything else we want to develop. We need to break loose from the federal straightjacket. One of the charter reasons for the amateur "service" is its mandate to experiment and pioneer new technologies, so why has the FCC so consistently hobbled us over the 46 years I've been dealing with them?

Instead of pushing to pioneer new technologies, we're all embroiled over preserving the oldest and slowest mode of electronic communications—CW. Well, it'll make an interesting story in the history books. Despite bitter opposition we did manage to get rid of spark. And we've almost gotten rid of AM. But CW Forever, right?

Webbing It

The Web is turning out to be what I'd hoped we could develop with ham satellites: a way for anyone anywhere to get in touch with anyone else. Anyway, if you're interested in checking into a Bioelectrifier page you can find Miller at [www.info com.com/~thomil/], and Far Circuits at: [cl.ais.net/far cir/], with the usual [http:// www.] lead-in. Yes, I know, I should have a Web page too. If I had one I wouldn't have time to service it, so get off my back. If you have any other Web sites we should all know about, let me know. With some significant encouragement we'll run a regular listing of Web sites which could interest you.

The FDA

In a recent interview on the Art Bell (W6OBB) show I was discussing the ways in which we poison our bodies, thus weakening our immune systems and making us more prone to both chronic and transient sicknesses. When I mentioned the mercury poisoning that results from dental amalgam used in filling teeth, Art protested that his dentist, in whom he had faith, said that was all a bunch of baloney. Ditto my pointing out the poisons teeth with root canals pour into our bodies. My credibility was at a low point with Art.

Then a couple of dentists called in and backed me up, citing the credentials and work done by Dr. Meinig, who wrote *Root Canal Cover-up*. I've reviewed his book in my editorial and it's in my guide to "books you're crazy if you don't read." Ditto Dr. Huggins' book on amalgam, *It's All In Your Head*. 98% of people with multiple sclerosis have mercury poisoning.

Yes, the ADA is doing it's best to discredit these two pioneers. You can tell a pioneer by the arrows in his back in any field. In the cold fusion field the ridicule and humiliation is continuing, despite the recent NASA research report totally confirming the cold fusion phenomenon.

A recent book by Elaine Feuer, *Innocent Casualties*, Dorrance Publishing, 1996, $15, 174pp, ISBN 0-8059-3819-2, is a harrowing exposé of the FDA's war against any non-drug alternatives for curing AIDS. The FDA, though provided with solid proof that True Health had a dietary cure for AIDS, crushed the company. It wasn't patentable, so the drug cartel couldn't make billions of dollars.

With each accepted new drug providing an average of $231 million to feed the tens of thousands of FDA employees and administrators, and taking an average of 10 years to be accepted, any inexpensive cure for anything is fought with every weapon at their disposal, and they have their own SWAT teams.

Get the Book

Then, if you still think old Wayne is getting soft in the head, read Lydia Bronte's *The Mercury In Your Mouth*, subtitled, "The truth about 'silver' dental fillings," citing such effects as fatigue, nervousness, headaches, memory lapses, allergies, depression, irritability, and lack of concentration. It's $15 from Quicksilver Press, 10

Continued on page 40

Number 6 on your Feedback card

LETTERS

From the Ham Shack

Nick Leggett N3NL. There is a company offering very large capacity capacitors (50F and larger) that may be very useful for amateur radio. The 50F double-layer capacitor measures 25mm in diameter and 40mm in length. It is rated at 2.5V, has .08Ω internal resistance, and sells in thousand lots for $13 each. The part number is DZ-2R5D506. The company offering them is ELNA America, Inc. 10529 Humbolt Street, Los Alamitos CA 90720. They have a web site at [http://www.elna-america.com]. This type of capacitor could be quite useful for amateur radio. Several can be used to store energy for portable and handheld devices. Think of the glorious time constant possible with 1000F of capacitance. Another, more unusual, use could be in a resonant circuit for the longwave experimenter's band.

I am personally interested in using these super capacitors for energy storage for model hovercraft, model electric aircraft, and model ionocraft. Probably the best place for a modeler to start is building a power boat. Boats have the least energy requirement. These capacitors could be a lot of fun for the experimenter and they could stimulate a lot of new ideas. These capacitors have the advantage of small size. They are designed to be mounted right on a circuit board. This is a contrast to the massive double-layer capacitors being used by electric vehicle researchers. Wouldn't it be good if amateur radio operators pioneered this type of development? Keep up your efforts promoting amateur radio research and invention. That is where the fun is and it is good for the nation.

It's difficult to tell the difference between large capacitors like these and batteries. I've been expecting miniature Farad capacitors ever since Takahashi got patents on a new dielectric a couple years ago. He's the chap who invented the super magnets used in his magnet-powered scooter ... Wayne.

Jack Lee KC5NGS. Wayne, we agree on so many issues that I just subscribed to *73*. I read your "Never Say Die" for the first time and can't wait for the next issue. I've been a ham for two years and just read my first *73* magazine. It's great! I agree that the code requirement should be reduced to 5wpm for HF privileges. I just upgraded to General Class. I enjoyed learning the code, but so many never meet the challenge. I say let's drop it and build our ranks. I sometimes think I may be off base, but then I read someone like you with many parallel views.

Thanks for the vote of confidence. If you happen to run into a thinking ham on the air, tell him about 73 ... Wayne.

Ron Gang 4X1MK. Say, I agree with almost everything you say but the business about beards. Well, I can't say if all college profs are masked bandits (hi), but being bearded is the male Homo Sapiens' natural state. Scraping of the facial hair with a blade is a custom of certain societies, attributed by some to Alexander of Macedon 2,000 years ago, who had his soldiers shave, so in battle, their opponents would not grab them by their beards and chop their heads off. I did indeed notice that in North America there are many fewer men with beards than here, no doubt due to social pressure. But since I gave up shaving 18 years ago, I haven't missed it a bit. I don't think of myself as a bearded person, just a regular person, and the lack of shaving didn't help me be more outgoing or any of that stuff, in fact I can't really think of any psychological changes that came with it. But I no longer suffer from rashes or other skin disorders on/of my face. I'm not putting down men with clean-shaven faces, if they like it, it's fine by me. A face is a face, and if it has a beard on it, that's part of it, as Nature has allowed. Nuff said on that point! On to more serious matters. I saw a device at the home of a friend in Canada that may interest you. I forget the name of its inventor (now the name Lakhovsky comes to mind), but the idea seems to be the same as the Bioelectrifier. In short, the device is a spark gap transmitter with continuous pulses of sparks fed into an antenna consisting of two disks of PC board with a circular kind of log-periodic etched out. You sit between these two poles, absorb the energy. The theory of Lakhovsky was that all cells have a resonant frequency, and disease happens when they go off their frequency. The pulses of wide-band RF knock them back onto frequency, and then everything is OK again. This may be a gross oversimplification, but that's how it was explained to me. There's literature out there and the device is commercially available. You're supposed to drink a lot of water after using the device, as there's a lot of detoxification happening in the body, and you need to drink the H_2O in order to flush out the poisons. And more serious matters. So, we've taken our bodies in hand, maximized our health. So what then? The most important thing may well be doing something with ourselves, the entities called human beings. Not just to amuse ourselves by various life games, like making money or amassing power. It would seem important that we maximize our potential in terms of becoming more aware, conscious. There may be clues in various esoteric traditions, many from (but not necessarily) the East. There are plenty of disciplines around for greater mental hygiene and unfolding the human potential. We've got to see if we can find out where we fit in with the whole scheme of things. G. I. Gurdjieff makes some interesting reading. Maybe hams may be more esoterically inclined. Is not the fascination with radio partly that it enables us to transcend the barriers of physical space and time and travel instantaneously far off? OK, pal. I've been reading your musings for over 30 years, so here were some of mine. Take care, and I can trust that you'll keep throwing in stuff to wake your readers out of their slumbers and think more about the nitty gritty.

No, Ron, amateur radio is a hobby. And the Lakhovsky oscillator is a lot like the Rife approach, except it creates more TVI. I'd sure like to see convincing evidence that either of these gadgets work so I could publish articles on them. Until then, they look like expensive placebo triggering devices to me. If there are any readers with solid data, I'd love to see it. Beards, some of them really weird, seem to be standard in Israel; over here they're more a way to either hide or flaunt one's face ... Wayne.

Warren Bain N4WMU. I have been reading your magazine for years and thoroughly enjoy it. I have found your editorials entertaining and informative, and have taken up several of your challenges, like NRA, Never Re-elect Anyone. It has not made any difference, though, since most people don't care or can't be bothered. I did order the NASA book, and to paraphrase General George C. Scott, René, you magnificent bastard, I read your book! I agree with many of his assertions. I am a reasonably good amateur photographer and have been looking at the NASA photos with a critical eye. I will go to the Air and Space Museum to get some of the photos and check them myself. I cannot agree with your assertion that a college degree is worthless, except your more Liberal Arts courses, as anything which makes you think is good. I received my BSEE and am better off since I can see through all the false technical claims which pass as information on various subjects. I bought the parts for the Bioelectrifier and will do some testing myself. Who knows? It may be the best thing since sliced bread.

College is fine if you have nothing better to do for four years and have no aspirations for making either money or a mark in the world—a profile that seems to fit a discouragingly high percentage of the motivationally challenged public ... Wayne.

Rick KE3IJ. I have really begun to appreciate your editorials; also appreciate your open-mindedness with regard to one of my areas of intense interest: "Weird Science" or, to put it more optimistically, Today's Dreams ... Tomorrow's Technology. I was particularly hoping to see an update on the fellow you mentioned who amplified biofields inside a Faraday cage and regenerated living organisms ... I've toyed with the same idea (but never got off my arse and did it!) ever since I ran across a series of books by Tom Bearden (Tesla Book Co.). Bearden is the father of "Scalar Electromagnetics," which is allegedly the missing link between mainstream electromagnetics/physics and the mysterious world of paranormal phenomena, electrogravitation, sub- or hyperspace communications, time-warping, and, related to the above, re-programming/regenerating a living organism by "correcting its scalar EM signature" (aura or biofield) via interfering Fourier expansion patterns to create a 3D "healing" field in and around that organism—a sort of synthetic "morphogenetic field" à la Rupert

Sheldrake. I recommend Bearden's many books highly if you haven't already run across them. He has one dealing with AIDS as a government-engineered virus and how Scalar EM could be employed as a healing means. I've also discovered quite a wealth of material on the Internet just by going to [http://www.yahoo.com] and typing searchwords such as psychotronics, biofields, phase conjugation, etc. One source, here in PA, allegedly invented and sells an electronic "aura reader" device said to operate on Resonant Field Imaging principles; his doodad supposedly correlates almost perfectly with the observations of clairvoyants who see certain colors in people's auras. He markets and consults to the alternative health crowd. Here are a few interesting web addresses if you're in a browsing mood. The Aura guy I just described: [www.thebook.com/mindbody/]: The KeelyNet, for which I occasionally write speculative files: [www.keelynet.com]; Leading Edge Research Group, an alt-sci/mystical site: [www.cco.net.~trufax/convers/conrpt.html]. Tom Bearden writes for the Huntsville AL *Virtual Times*: [www.hsv.com] (find Bearden among other writer links way down at the bottom of the page). There are lots more, of course. Just thought I'd let you know of some I've come across. And I am really "bugged" by your "biofield regeneration" anecdote. I wonder how wideband that wideband amp was. Assuming that our focus is in the audio band, what will happen feedback-wise if we use, not a microphone and a speaker, but a pair of Helmholtz coils (one pickup and one transmit) with positive feedback and our organism inside the field? With no acoustic feedback, "howling" would seem to be eliminated: RF oscillation shouldn't happen either if we limit the bandwidth. Can we saturate an animal in an amplified version of its own biomagnetic field, for good or ill effect? How about the problem of 3D? Should we have three pairs of coils, for X, Y and Z axes? I know, I know, I should get off my rumpus and *do* something.

You've mentioned the "crazy" books that call NASA's space program a staged farce; how about THIS one: SETI may be a farce, says a source I came across, because they're looking for ETs up in the MHz, etc., when NASA allegedly "knows darn well" that aliens use time compression (related both to Relativity and to Hartley's Bandwidth/Information equation) and communicate using what *we* perceive as ELF (such as brain-wave frequencies, Earth's Schumann resonances, etc., from 1-100 Hz). Such signals could be all around us, but we don't perceive them because they're too slow for us to hear; yet the aliens transmitting and receiving perceive them as at normal RF at MHz frequencies; their time-rate is different from ours. Think about the reports of UFOs flitting around at impossible speeds, dematerializing, and especially changing colors like a rainbow when accelerating. That sounds like Doppler shift of light, which could be observed if "time fields" could be created which "warp" an area with respect to the ambient ... just food for thought. Meanwhile, please keep up the good inspiring "Never Say Die" editorials and thanks for your time.

I've been reading Bearden's stuff for about 30 years now and it's never made any sense to me. Scalar-schmalar waves ... Wayne.

John Waudby KM6MB. I read René's books some time ago. One point: I was going through a CD-ROM yesterday and on it was the sound and video of the "first Moon landing." (I put it in quotes as I too am skeptical.) Lo and behold! I asked my XYL if she noticed anything odd and played it back several times, but she didn't. So I said, "Where is the delay?" I was taught that radio waves travel at or near the speed of sound. Well, someone should have told NASA! When ground control (or should I say the recording control room?) sent a "radio" message to the boys "attempting to land on the lunar surface" these boys answered as if they were in the same room. There was no delay!

Isn't the moon approximately 250,000 miles away? So shouldn't there be at least a second's delay? Find a copy, Wayne, and listen to it for yourself. I also put a Bioelectrifier together and use it for around 30 minutes a day. I hurt my wrist a few months back and noticed it relieved the pain. I'm also a "chrome dome" and I have noticed some comeback of my lost crowning glory!

Hmm, yes ... when I worked moonbounce ham contacts using the big dish at Arecibo there was about a three-second delay. Theoretically there should be about a one and a half-second delay for an Earth signal to get to the Moon and another second and a half for the response. Tsk ... Wayne.

Balaji Gopalakrishnan. I came to the US six months back from India for studies. Some days back I also began to revive my interest in ham radio. The result is I am now going to get an Advanced Class license (I took the exam seven days back). I cleared the 20wpm code test on my first exam ever. Although I did not study for "Extra" theory, I missed it by just one point.

I think the phenomenon you described in your "Never Say Die" column, of fewer and fewer people becoming hams, is a global phenomenon. Thankfully, most countries (including mine) don't have powerful companies (like AT&T, Raytheon, etc.) so we don't need to worry about our spectrum. Ham radio is taking a beating from the Internet, cellular phones, and the fact that people don't like to spend months learning an archaic language which they will never use outside the ham radio domain. I was an SWL for 10 years but could never get over the code barrier until I bought some practice tapes, so I now can receive well at 17wpm. I also assembled a QRP transceiver, which obviously is CW, so code does help in getting on the air if a ham does not have the resources to buy SSB high-power equipment. But it should not be a barrier to "the common people" from using voice on HF.

Coming back to the issue of spectrum space, I think we had better get used to losing parts of the spectrum. The positive side of this is that we will have to use equipment for narrower bandwidth, so people might go back to CW!

About the review in your May '97 issue of the WB9KZY Island keyer. It is not appropriate for the guy selling the keyer to review it.

I can't think of anything else to pour out to you (actually I had, but I can't remember).

Yes, now I've got it. The ARRL is barking up the wrong tree trying to lobby the companies trying to buy out spectrum. I think you're right, we need more political clout. And if we abolish CW for the license I think our ranks will swell like never before and everyone will be happy (ARRL, Yaesu, Kenwood, Icom ...) and with the increased numbers of hams we could possibly even justify keeping the spectrum.

Here's another troublemaker ... Wayne.

Dave Grieco K3KEM. Just a note to let you know I just finished building Tom Miller WA8YKN's Bioelectrifier. I picked up a blank circuit board from FAR Circuits at the Dayton Hamfest. I noticed that the printed circuit board from FAR has a few small errors in that some of the traces are incomplete, a mislabeled resistor (R6) and the polarity of the LEDs is reversed. Nothing you wouldn't miss while stuffing the board. I also noticed the values of C1 & C2 should be as close to each other as possible to keep the timing the same on each side of the current reversal (I opted for 47µF which gives a reversal time of about five seconds.)

Using 68k resistors in place of VR1 & VR2 will yield a current across the electrodes of up to 100mA! Using the 1 meg current pot in series with one output lead allows you to crank the current down to the 50 microamp range. I am pushing sixty and am in excellent health, so I have no ulterior motive to build the thing other than for the fun of it—although I could use a few extra hairs where I park my hat! The next step is to find some silver for the electrodes.

Sixty, and still healthy? Amazing! If you get desperate for 99.999 fine silver, Radio Bookshop has some available. I've been buying rolls of #10 pure silver wire and lopping off two three-inch lengths to help the readers make silver colloid ... Wayne.

Trevor Liberson GØMKO. I found *73 Magazine* while sailing in the USA last year. I was delighted with it, not only the style but the clear-thinking articles and the editorial. I would like to take it on a regular subscription basis but unfortunately my lifestyle prevents this. My wife and I did, however, benefit from this issue and let me explain. We live on a small sailing boat. We are currently cruising the Southern Caribbean. We came to Trinidad two months ago to watch the carnival. Carnival was great, but left us with its notorious aftereffect, "Carnival Flu," known also as "Carnival Crud" (by US sailors) or "Big Truck Flu" by the locals, even more devastating as we never get sick. We shook it off in a few days instead of the usual three weeks. Afterwards our thoughts began to turn to Thomas Miller's article on the Bioelectrifier. The idea of electronically bolstering the immune system seems mighty attractive, especially considering some of the nasties we meet in these parts, like

Continued on page 57

Number 8 on your Feedback card

QRX . . .

Cause for Concern

We told you about the severe downturn in the sale of higher-profit desktop ham radio equipment in the United States. There are a number of industry observers who believe that this could lead to some Pacific Rim suppliers abandoning the US market.

The question then arises: If one (supplier) were to pull away from North America, what (would) happen to it? The answer is that any who do will not just survive but may even do better than continuing to deal with marketing to United States hams.

There are two reasons for this. First is the huge market in Japan where no-code hams are permitted to operate SSB phone on the high-frequency bands. In case you are not aware, Japan has more than six times the number of amateurs the United States has. And, unlike hams in North America, most Japanese radio amateurs purchase the newest and latest desktop high-frequency transceiver as soon as it's available. They are also used to paying full price with no discounts.

Also, there are the burgeoning South American and European markets. Again, discounting is unheard of and getting in line to be the first with a new-model radio is very common.

Most of the same Pacific Rim manufacturers that bring you ham radio gear also sell high markup two-way land mobile equipment. That market is exceedingly strong worldwide and offers profit margins that are generally quite high.

From the May 1997 issue of *Squelch Tale*, newsletter of the Chicago FM Club, Inc.

CQC Top Ten Secrets of QRP DXCC

10. Get a *Callbook* and a bunch of blank QSL cards and "Roll Your Own!"

9. Start sending or calling before the last guy has finished.

8. Break the pileup by working mixed-mode. When everyone is shouting their callsign, *send* yours in Morse.

7. Break the pileup by working mixed-mode (2). Really stir things up by shouting your callsign on SSB over a CW pileup.

6. If operating CW, sign "QRP YL." If operating phone, get a female or female impersonator to make the call.

5. Send a series of Vs at a kW before dropping back to 5 W to send your call. Gets their attention every time.

4. Get a QRO station to "relay" for you.

3. Run 100 W or more and sign "/QRP10MW."

2. Tell everybody you've *done* it, but just can't be bothered with the paperwork.

And the number one secret of QRP DXCC:

1. Just log it. If you could hear him, you *could* have worked him.

From *Low Down*, official journal of the Colorado QRP Club (cqc@aol.com).

Congress Acts to Protect Volunteers

We said it couldn't be done, and so naturally, Congress went and did it! In one of the more promising—not to mention surprising—developments so far in the 105th Congress, the Senate has passed S 544, and the House has passed a companion bill, HR 911, each described as "The Volunteer Protection Act of 1997." The Senate is expected to adopt the House version of the bill, HR 911, and send it along to the President for signature.

As a result, volunteers of non-profit organizations and government entities will, in the words of the House Judiciary Committee report on the bill, "generally be relieved of liability for harm caused if ... the volunteer was acting within the scope of the volunteer's responsibilities."

This will be good news to Volunteer Examiners, Official Observers, ARES and RACES volunteers and others working under the sponsorship of a qualifying non-profit organization, all of whom appear to be covered by HR 911. In non-legalese, this means that you aren't as likely to be sued as a result of harm unintentionally caused to someone else, if your actions were part of your responsibilities as a volunteer working on behalf of a government agency or a non-profit organization.

However, until the bill is signed by the President and its various loopholes pass the scrutiny of the legal community, volunteers shouldn't assume they'll automatically be covered. It appears, for example, that radio amateurs who are not working under the sponsorship of a qualifying organization and who volunteer to provide communications during a marathon, bicycle race or other public service or public safety event might not be covered. The same exclusion might apply to frequency coordinators and certain others who—though they are volunteers—aren't participating on behalf of a non-profit entity. While these individuals could affiliate with government or non-profit entities to do their volunteer jobs, the law will clearly protect only those who are "volunteers of a non-profit organization or government entity." The definition is clear with respect to government entities, but it is less clear with respect to "non-profit organizations." These can be Section 501(c)(3) entities, that is, an organization holding a certain tax exemption from the IRS. They also include, however, those organizations which may not be tax-exempt, but which are organized and conducted for public benefit and operated primarily for charitable, civic, educational, religious, welfare, or health purposes.

The growing reluctance of private citizens to volunteer for fear of lawsuits triggered interest in this legislation. While some states have enacted volunteer protection statutes, the inconsistency among states has resulted in what the Judiciary Committee calls a "hodgepodge." As a result, the League has promoted liability legislation in Congress for several years, initially to protect VEs and Amateur Auxiliary members.

The new legislation requires that the volunteer be licensed, certified or authorized, "if appropriate or required" by state or local authorities. It does not provide protection where the harm was caused by willful or criminal misconduct, gross negligence, reckless misconduct, or conscious, flagrant indifference to rights or safety of the individual(s) harmed by the volunteer. The House version of the legislation would not cover any volunteer who inadvertently caused harm to another person while operating a motor vehicle that requires an operator license or insurance. Also, certain limitations in existing state volunteer liability laws are not preempted by the Federal protection under the bill.

The ARRL's General Counsel Chris Imlay W3KD is studying copies of the House and Senate bills to determine the impact on amateur radio volunteers of the new legislation.

Copied from the June 1997 issue of the Maple Valley Amateur Radio Club's *Maple Valley Hamlink*; it originally appeared in the May issue of *The ARRL Letter*, prepared by the ARRL.

FCC Proposes, ARRL Opposes

Vanity fee hike... Last month, the FCC proposed effectively raising the fee for a vanity callsign from \$30 to \$50 for the 10-year license term. Now, the ARRL has asked the Commission to postpone the higher fee until after all four vanity callsign gates have been opened. In comments filed April 23, the ARRL told the FCC that it does not object to the fee increase, per se, but said that it wants all hams to have an opportunity to request a specific callsign under the current fee schedule.

The fee increase was among those included for all FCC-regulated services—including broadcasters and commercial satellite services—in the NPRM in MD Docket No. 96-186. Under the proposal, the FCC "rounded up" all FCC-imposed \$3 annual fees to \$5 per year—the lowest in the new schedule. The ARRL noted in its comments to the Commission that because projected revenue from the vanity fee increase "significantly exceeds" the revenue needed to cover the costs of administering the program, a delay would be reasonable. The ARRL also asked the FCC to limit the vanity callsign fee to the minimum it needs to recoup its costs to administer the vanity program but "without rounding to a significantly higher fee." The FCC adjusts its fee schedule every year.

TNX to the May 1997 issue of *The GCARC Wireless*, which reprinted from the *ARRL Website, Bulletin ARLB022.*

Video Transmitter

Delta—the ATV transmitter you can change to fit your needs. Three bands, one design.

Jeff Johnson KC5AWJ
17423 Landon Oaks Drive
Houston TX 77095
[kc5awj@stevens.com]

ATV was the reason I got my ham license. Being able to talk to people without using Ma Bell was OK, but being able to see them at the same time—no slow scan for me—was *cool.*

I had been attending HATS and South Texas BLT meetings for several months before I got my ticket, and I was able to observe many different systems, both on 440 MHz and 1.2 GHz. I was a new ham with little or no equipment, no disposable income—but lots of spare parts. My options were down to one—build it myself.

I looked at all the circuits and equipment I could find, for ideas about which manufacturers made parts for ATV frequencies. By this time almost a year had passed and HATS had determined that the Houston area did not lend itself to in-band 440 MHz ATV. My focus was abruptly narrowed to creating a 1.2 GHz transmitter.

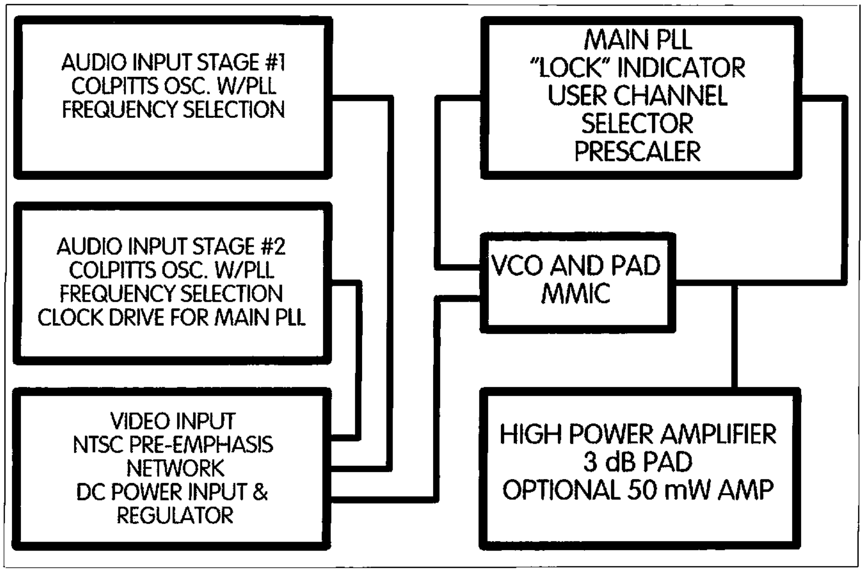


Fig. 1. *System block diagram.*

Alpha board

I found a chip that would phase-lock a 1.2 GHz signal using a crystal control. This was great! A one-chip solution to my problem—and there were application notes for building a 1.5 GHz VCO to use with the chip, a Plessey SP5070F that cost about $17. Not too bad, I thought, and I didn't think the other parts would be any more difficult to find in small quantities. *Wrong!*

I could get samples of some of the parts but most had a minimum purchase quantity of 3,000-5,000 pieces. I spent several weeks searching for alternate sources and components, and finally wound up with enough samples to build two prototypes, following the VCO application note, and another eight or nine variations on the theme.

I created artwork and made the first circuit board. I had all the video components but couldn't find the transformer

used in the audio circuit I had found in the *ARRL Handbook*. Well, I had bitten off a lot on this first board, so I gave up trying to find that stupid transformer and concentrated on the video section. Video pre-emphasis and two transistor gain stages weren't too hard to debug—but nothing came out the other end. It was at that point that I found out why they call them application "notes." Nice idea—but has anybody ever built it to see if it *works*? Two weeks later, after calls to anyone who would listen (and a few that didn't want to but did anyway), I'd got to the point of finding out where the free-running frequency of the VCO exited—disconnected from the PLL and video signals. Surprise! No wonder the PLL wouldn't/couldn't lock. It couldn't correct a VCO running 100 MHz too low on the voltage I had given it, and I didn't have a 17-volt car battery handy to correct the problem. I spent another week tweaking that sorry VCO. Actually, it wasn't *that* bad (I'm still married). But *now* I was getting cocky. I had a VCO that would free run at 1170 MHz. I reattached the PLL and it locked on frequency. Then I added the video.

A little more troubleshooting on the video board—and what do you know ... It actually worked.

Beta board

Some people were so impressed that I'd made a low-power ATV video-only transmitter for under $40 that they wanted one too. Buoyed by the fact that I'd survived the Alpha, I boldly conceived the next board—but I was smarter this time.

Audio would go on its own board until I resolved the parts problems it created. About that time I was shown an article from *VHF Communications* on a 13 cm ATV exciter. Their design had moved many of the "flying" parts onto a 50-ohm stripline on the PC board. This made a lot of sense: fewer parts to break off; a 50-ohm trace to make the MMIC amplifier happy; and a match to the coax going to the high power amplifier.

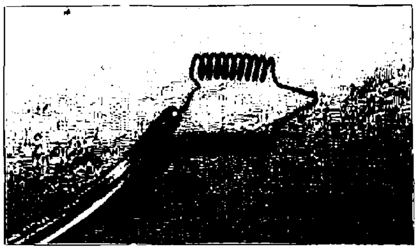


***Photo A.** Coil with both sides spread. No more curve!*

I was on the right track. Once more, I began creating different VCO designs using my free samples. I made up the first of eight boards and gave it to my first victim. He got it to work in a matter of hours, and made his own audio circuit. Unfortunately for him, my first victim did such a good job of making my mess work, he got to help with most of the rest of these little beasts. Somewhere around the seventh or eighth VCO. I got samples of a TriQuint general purpose downconverter, the TQ9272. One section of it contained a VCO with buffered outputs. All it

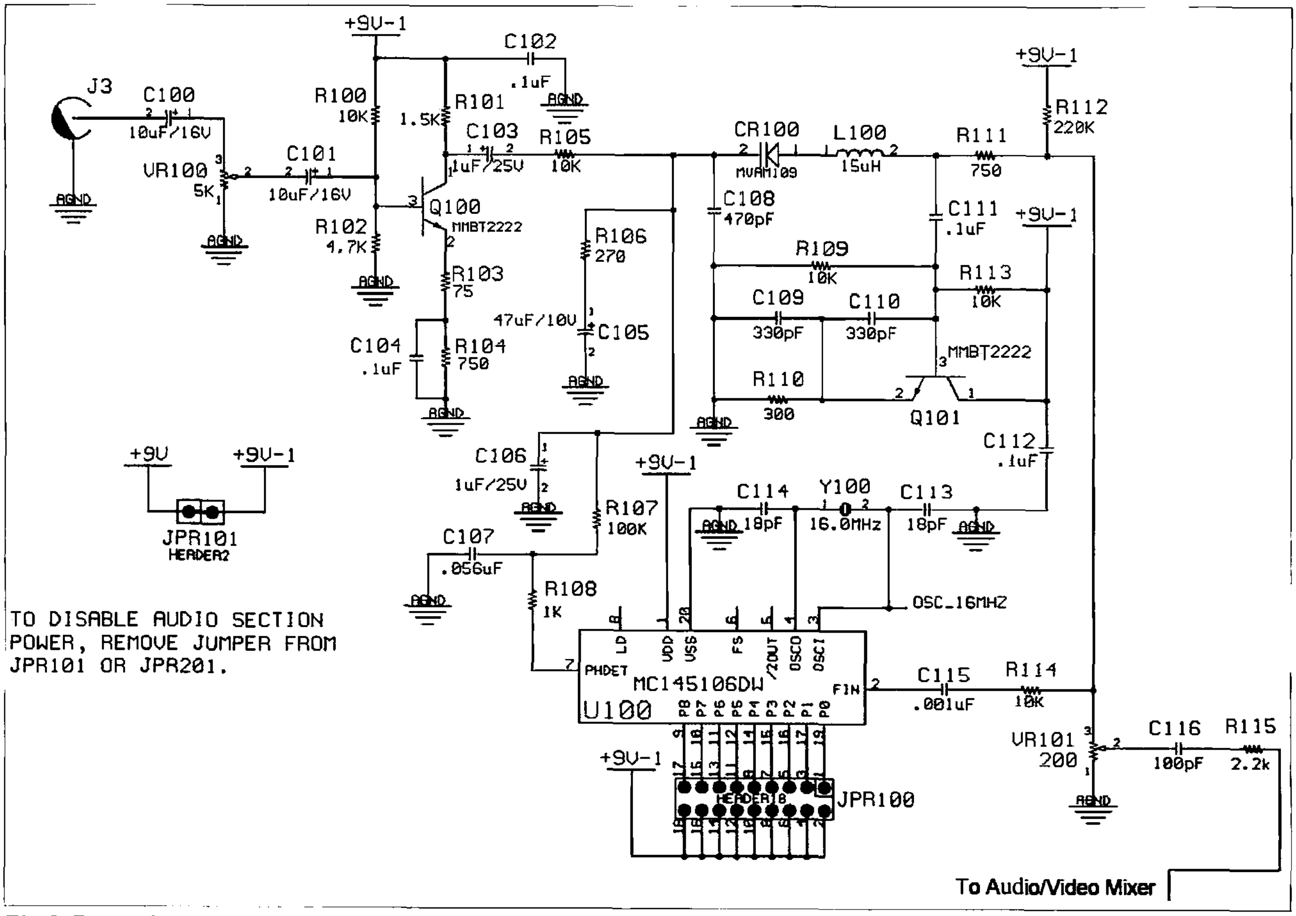


***Fig. 2.** First audio subcarrier. In all schematics, resistance is in Ω and capacitance in µF.*

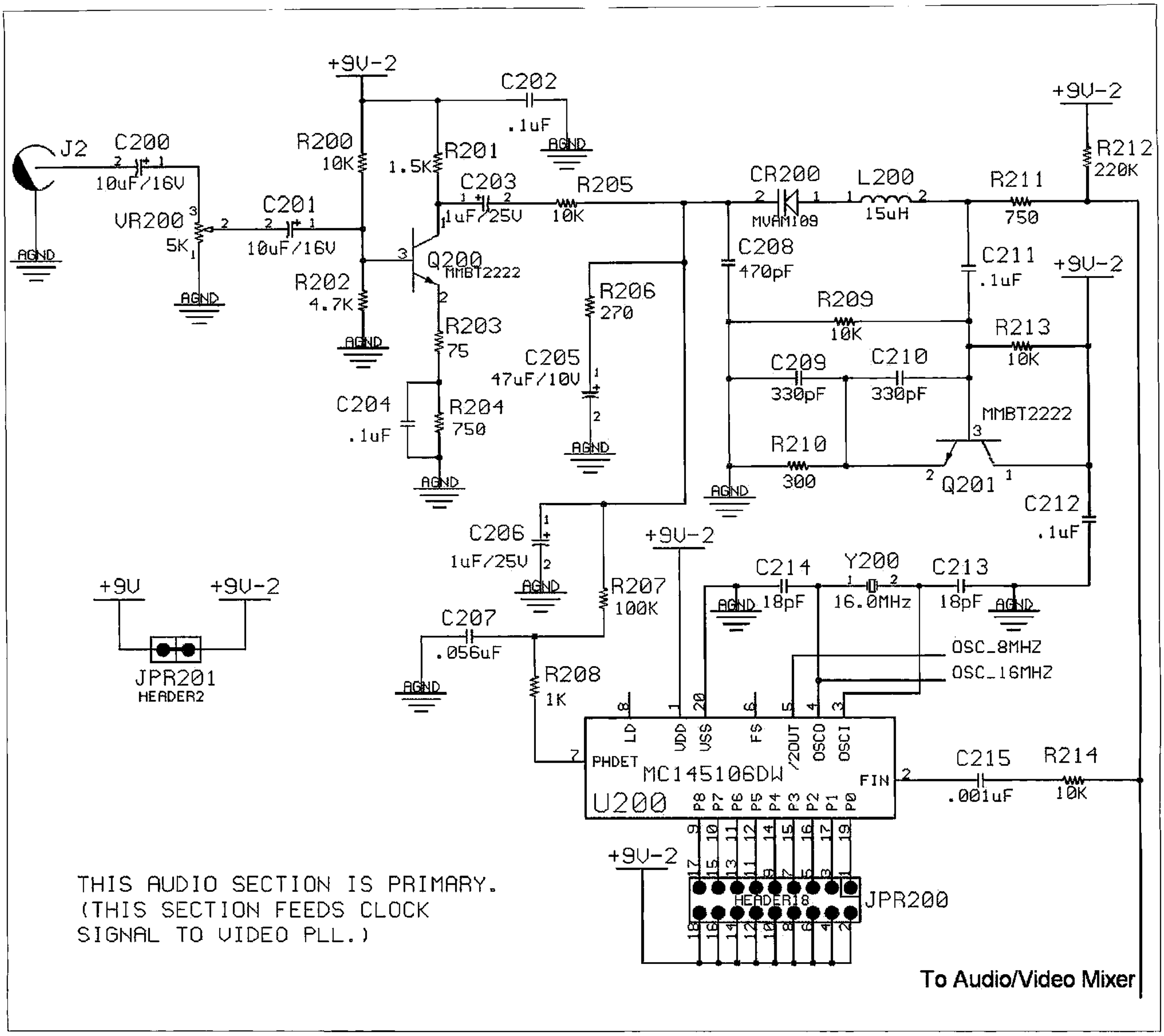


Fig. 3. Second audio subcarrier.

needed was a small inductor—a short piece of wire—to set the general oscillation frequency. The downside? It cost $25 each in quantities of 25 or more.

Charlie board

The most obvious problem with the prior boards had been the inability to create reliable quantities of VCOs. The second problem was inherent in the SP5070: a fixed prescaler divide ratio with a PLL using a set divide and comparison ratio. What all that jargon means is that I could have only as many frequencies as I could find crystals to create them. This meant one or two frequencies using readily available crystals; any other frequencies would be special-order, big-bucks crystals. The third problem was finding a good audio design with parts that could actually be purchased in *reasonable* quantities.

The entire process seemed to be a guided evolution. I just didn't know who was doing the guiding. I'd been searching for something but didn't know what I was looking for.

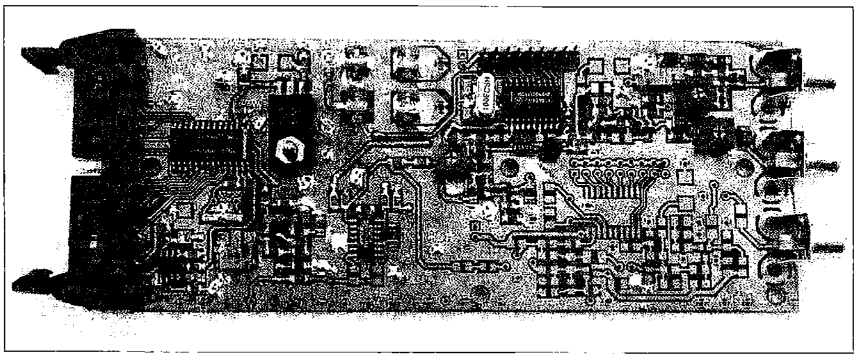


Photo B. Audio/video section of completed Delta transmitter (only one audio section used).

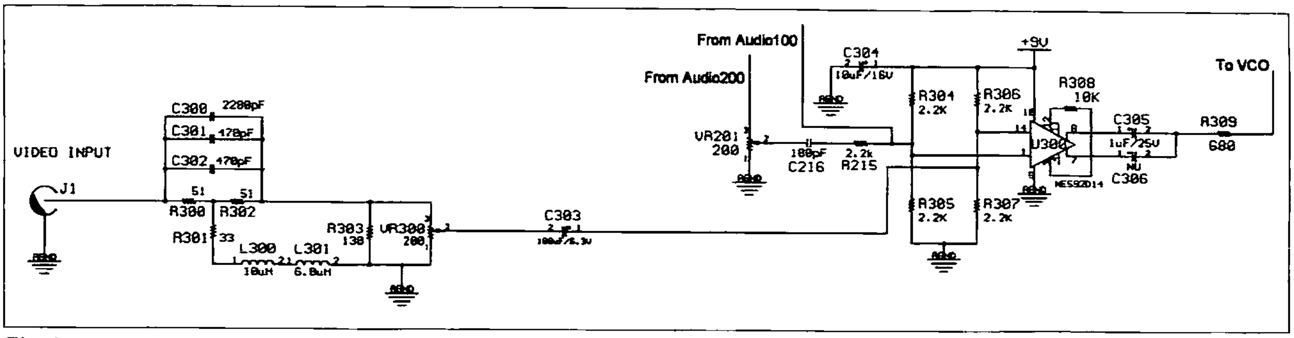


Fig. 4. Mixer.

Another HATS member gave me a copy of a magazine, and inside was a small ad: VCOs for under $10. I figured I had nothing to lose and gave them a call. Yes, they would sell smaller quantities, but the price was higher than the TriQuint part. These nice folks offered to match TriQuint's price to be "designed in." My VCO creation problems were over.

I was working on another project at my *real* job, which required me to look in a data book I had never paid much attention to. This wonderful book was the *Motorola CMOS Special Applications Handbook*. Inside were more PLLs than I had found in the previous two years. What made it especially nice were two parallel programmable PLLs. This meant I would not need a microcontroller to run an I2C bus or serial interface to the PLL. I could use a DIP switch. I would no longer have a one-chip solution; it would take two chips—but I gained hundreds of frequency selections.

The problem with the audio design was not so much its design as the parts I was trying to use. Although the varactor diode was a "preferred part" it also had a 20+ week lead time in minimum quantities of 5,000. Would you believe the part I needed was one page back from the part I couldn't get? It wasn't much bigger, cost half as much, was in stock for immediate shipment, and I could buy it in quantities of one. Yes, *one*.

Gee, wouldn't it be nice if someone else did all the bleeding for you? Well, how about burnt fingers and a couple square feet of mangled copperclad? Forthwith and hereafter, I present a design which shall be known as "Delta," containing the bits and pieces of knowledge I have gained/lost over the past three years in pursuit of a design for an ATV transmitter.

Frequency Range	860–1300 MHz, 2300–2500 MHz (Use only in authorized frequencies)
Channel selection steps	.25 MHz, 1 MHz
Output power	50 mW–2.5 W(+)
Video input level	1V p–p into 75 ohms
Video pre-emphasis	CCIR 405–1
Video modulation	Direct FM (up to 20 MHz bandwidth)
Audio input level	1V p–p into 5k ohm
Audio modulation	Direct FM (subcarrier(s) summed with video)
Audio subcarrier frequency	4–6.2 MHz
Audio step size	10–31.25 kHz (dependent on crystal selection)
Input connectors (3)	RCA
Output connector (1)	SMA
Input voltage	10.5–15 VDC

Table 1. Specifications.

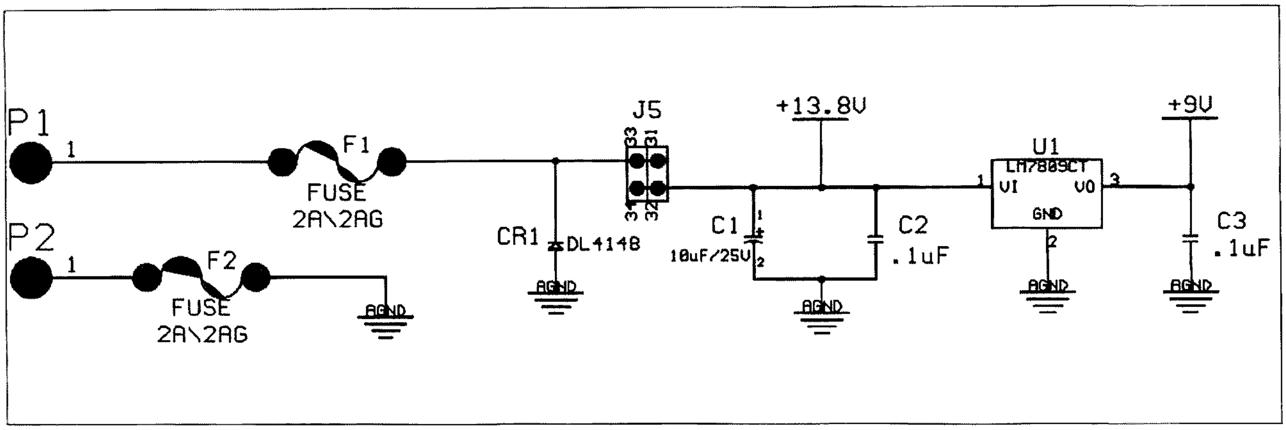


Fig. 5. Power input section.

Delta board

Some new features:

•Two audio channels with separate PLLs (stereo, or mono and one control frequency) and use of one, two, or three crystals for oscillation reference

•Board can separate into three modules—audio/video control, video, and amplifier module (high power: 2.5 W or low power: 50 mW)—for R/C and portacam use

•Uses a smaller, cheaper VCO with more available frequencies

•You get 900 MHz, 1.2 GHz, and 2.4 GHz with same board design

•Replacement of DIP switch (the contacts bounced in RC aircraft), power switch, and lock indicator with header strip allowing quick frequency changes using pre-made "keys" (uses 34-pin header, floppy disk cable)

•Unused audio sections can be powered down for power conservation

Don't be scared by the schematic. The way printed-circuit software works is that if you want an option it has to be on the schematic. There are lots of options here! The nice thing about this board is that you only need to stuff parts in the sections you want to use. The component numbers are broken up into

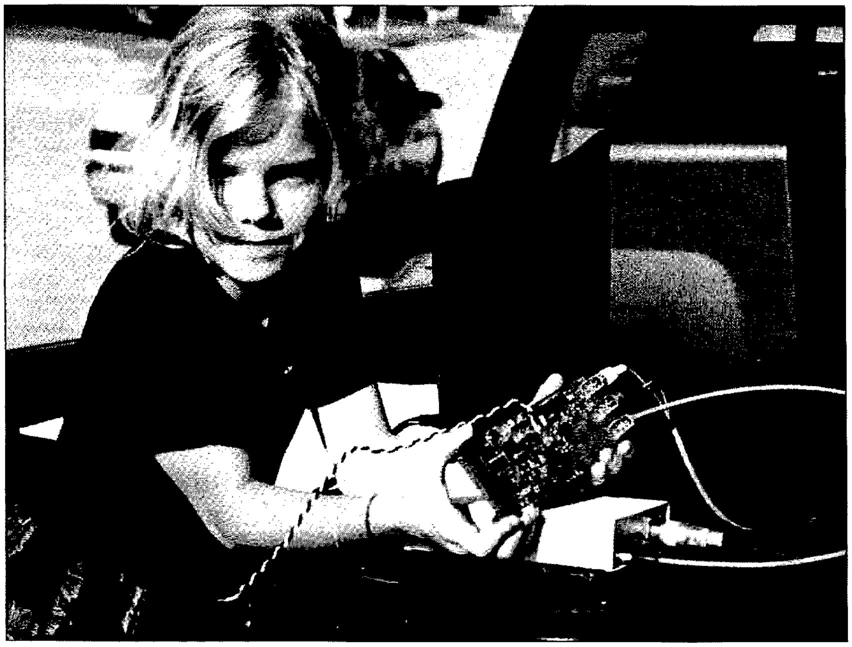


Photo C. Can I touch it? Am I holding it just right? Daughter Meredith holds ready-to-go Delta—just add power.

functional groups: the 100s and 200s are the two audio subcarriers; the 300s are the video amp section; the 400s are the main PLL and its circuits; the 500s are the VCO and buffer amp; and the 600s are the high-power amplifier for 1.2 GHz or the low-power amplifier for 900, 1200, and 2400 MHz.

The sections that will always be used are: the power input section (fuses and voltage regulator); the video amp section (NTSC pre-emphasis, combines video with audio channels); the main PLL with prescaler; and the VCO with buffer amp and pads. It wouldn't be ATV if it didn't have the video stuff. For those of you who want sound with your video the two audio channels can create stereo, or mono and a control frequency, or just mono.

The schematic as written is specifically for 1.2 GHz operation due to the frequency limitations of U600 (1240-1300 MHz). The VCO (U500) can operate from 860-1300 MHz. By using U601 (500-2500 MHz) in place of U600, you now have a dual-band transmitter with an output of 50 mW. The VCO and prescaler can be exchanged for other devices in the same size (parts list has device numbers) and will then transmit in the 2.4 GHz band with a 50 mW output. Additional amplifiers can be added outside of this assembly to allow as much power as the owner can afford.

What do you want to do?

After you have created/bought the printed circuit board the next step is to determine what you want the board to do and purchase parts accordingly. Will it be a base station transmitter? A portable camera with a link transmitter? Used in an R/C model? What frequency(s) do you want to use? Do you need one audio channel? Stereo? Two selectable mono audio channels set to different frequencies? How much output power is required? All of the above? Better make another board, or perhaps two.

Assembly

The air core inductor (L500) is made from #26 AWG magnet wire wrapped ten times around a form (piece of bare #12 AWG solid copper wire). Wrap the wire around the form in a tight single layer. Remove from the form, and, using a hobby knife blade (an X-ACTO™ #10 works for me), spread the windings apart by the thickness of the knife blade. Do this gently: you don't want to nick the wire or your fingers. One pass on each side of the coil will spread the wire uniformly. Remove insulation (carefully scrape with knife blade or use insulation solvent) for approximately one-half inch close to coil ends. Trim and form leads to fit pads on circuit board.

Remove some of the material from around the outside row of pins on connector J5. This will allow more room for the solder iron tip and make inspection easier. After soldering in J5, use an ohmmeter to check continuity between each pin and its destination. Also check for shorts between adjacent pins and to ground. The jumper headers can also be trimmed to ease soldering. Insert the headers and tack them in place from the bottom of the board. Carefully trim the plastic from the outside edges of the header until the component side pad is visible. Finish soldering the header in place. All through-hole parts should be installed first, and checked for shorts and continuity.

If you are using a commercially-made board, assembly is easiest if you solder the parts from smallest to largest, with the through-hole parts assembled last. If you have made your own board and did not do plated-through holes (they are beyond the capabilities of most hobbyists) you will want to do all of the through-hole parts first and then the surface-mount ones. Surface-mount parts have all of their electrical connections on one layer—the layer you can see. Through-hole parts connecting to traces on the bottom are easily inspected, but the traces on top are difficult to solder without leaving some space under the part, to

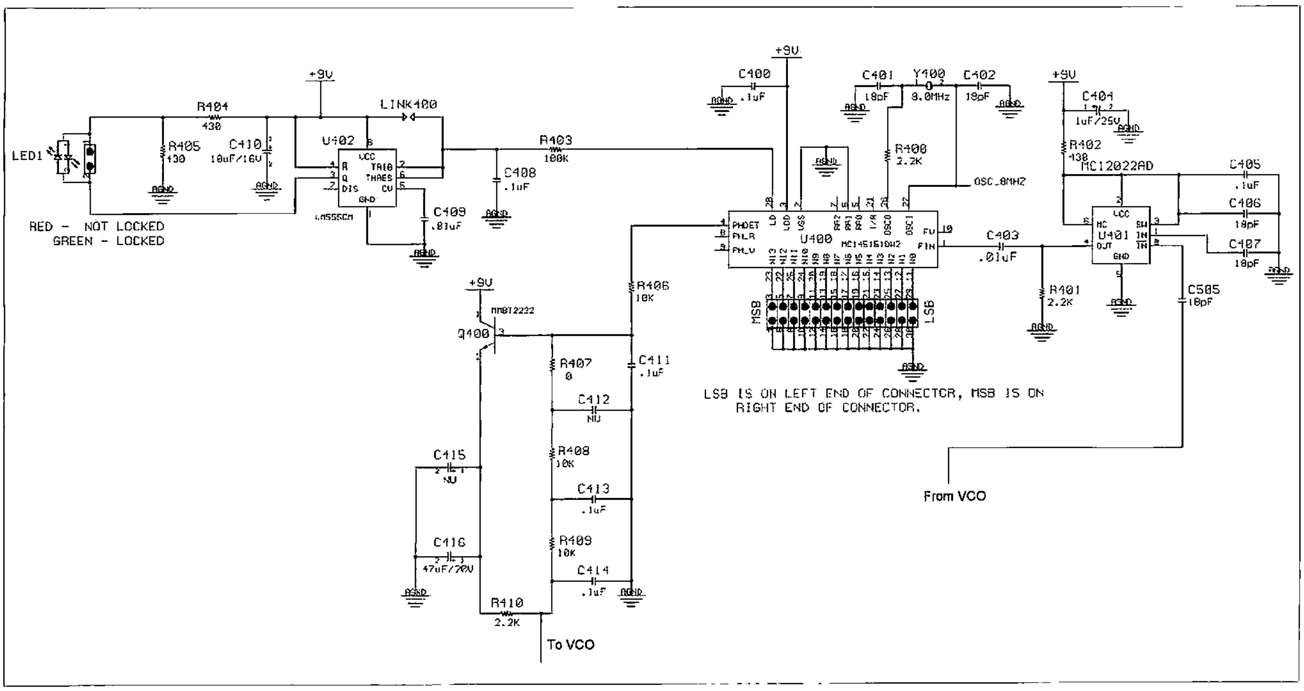


Fig. 6. Main PLL.

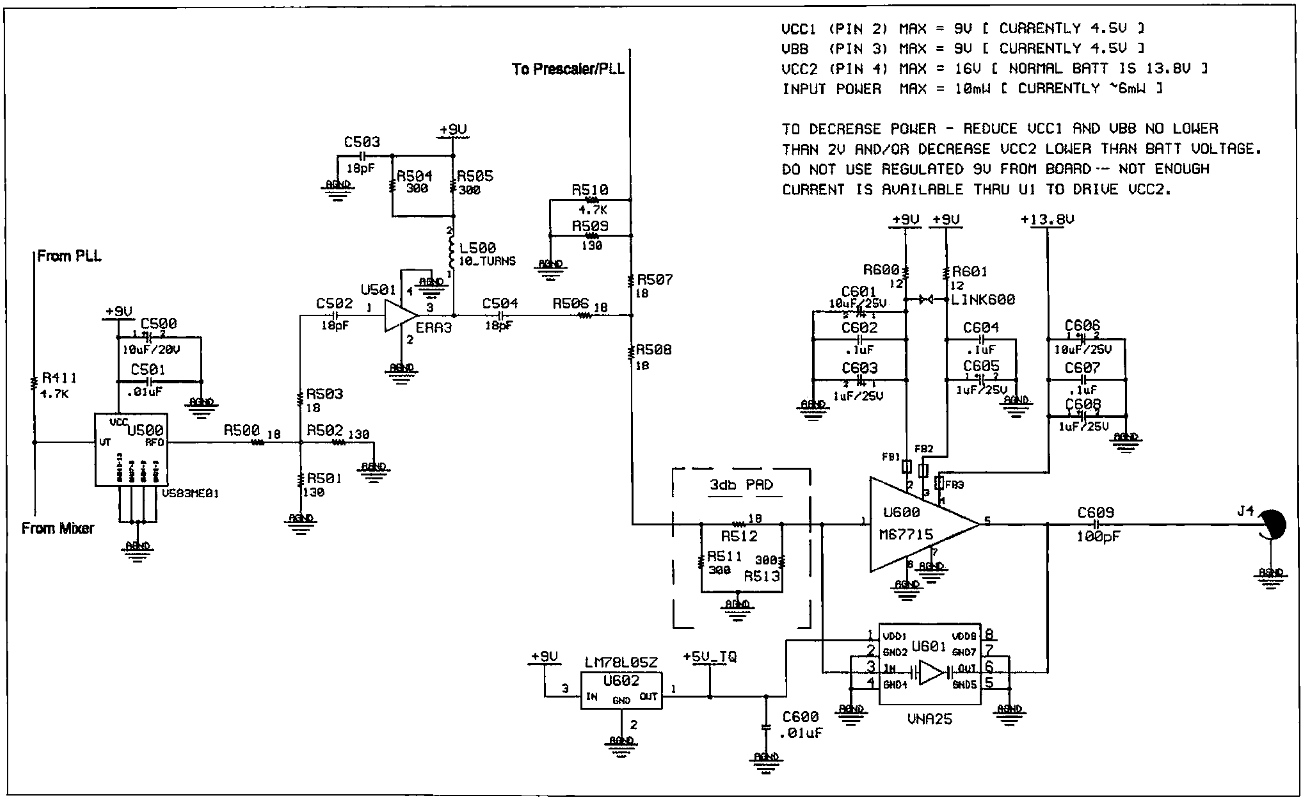


Fig. 7. High- and low-power amp. VCC1 (pin 2) max = 9 V (currently +4.5 V). VBB (pin 3) max = same. VCC2 (pin 4) max = 16 V (normal battery is 13.8 V). Input power max = 10 mW (currently ~6 mW). To decrease power, reduce VCC1 and VBB no lower than 2 V and/or decrease VCC2 lower than battery voltage. Do not use regulated 9 V from board—there is not enough current available through U1 to drive VCC2.

heat the lead and the pad. It also helps if you install the parts with larger quantities first. This makes it easier to tell where the single parts go because there are fewer places to look.

If you're making the high-power version, do not install U600 until the board has been tested and all functions are working. It's much easier and safer to test small signals than large signals.

Why three crystals?

The board needs one crystal to operate in standard mode. A 16 MHz crystal at Y200 provides reference frequencies to both audio oscillators, and using the /2 output of the audio PLL provides the 8 MHz reference for the video PLL. The board artwork connects Y100 and Y200 together and provides the /2 signal from U200 to the video section. By having the option of three crystals, I can separate the crystals from each other by removing a section of the trace connecting the two audio PLL crystal inputs together and have the video using an 8 MHz crystal (250 kHz steps at 1.2 GHz, 1 MHz steps at 2.4 GHz), one audio channel using 16 MHz (31.25 kHz steps), and the other audio using 10.24 MHz (10 kHz steps—but maximum frequency is 5.12 MHz). Any crystal can be used in the audio channels, provided the divide ratios work out to a whole number with no remainder, or the PLL will oscillate and be unable to lock.

Divide ratios of PLLs

Formulas for the MC145106:

PLL reference frequency:

(ref. crystal input freq.)(divide by 2)(divide by 2e9 or 2e10)

Oscillator frequency:

(oscillator output freq.)(divide by N) with N being the binary inputs P0 to P8.

EXAMPLE:

16 MHz crystal installed, 5.25 MHz oscillator output frequency desired.

16 MHz input divided by 2 = 8 MHz.

8 MHz divided by 512 (2e9) = 15.625 kHz.

15.625 kHz, or 0.015625 MHz, is our step frequency.

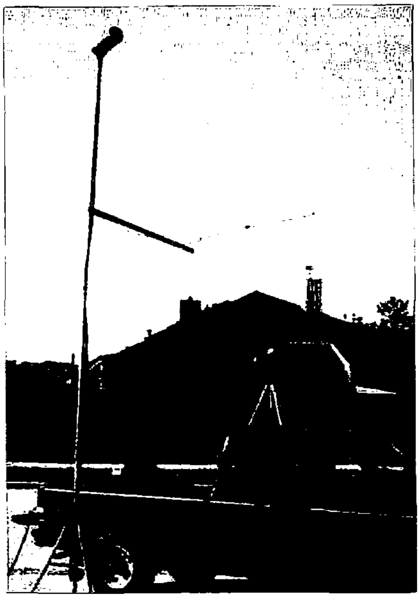


Photo D. Portable system configuration used during this year's March of Dimes Walkathon. Note Delta board to left of TV, above rear wheel.

5.25 MHz divided by (N) must = 15.625 kHz or 0.015625 MHz.

Therefore 5.25 MHz divided by 0.015625 MHz = 336.

336 = 256 + 64 + 16.

Inputs P8, P6, and P4 should be connected to the positive voltage supply. All of the P0-P8 pins have internal pull-down resistors and are at ground potential and inactive unless connected to the positive supply. Each audio section is independently powered, allowing unused sections to be turned off.

Formulas for the MC145151

PLL reference frequency:

(ref. crystal input freq.)(divide by reference address divide ratio value) = phase detect frequency

The reference divide ratio is set by connecting RA0-RA2 to ground per the manufacturer's table. The artwork sets this ratio at 2048. Other ratios would require "cuts and jumps" to connect the appropriate pins to analog ground (AGND).

Oscillator frequency

(oscillator output freq.)(divide by prescaler ratio)(divide by N)

with N being the binary inputs N0 to N13.

The prescaler ratio is set to 64 by artwork connections to VCC on pins 3 and 6. This ratio will allow 0.25 MHz steps on the 900 MHz and 1.2 GHz bands. For usage on the 2.4 GHz band, a different prescaler chip (MC12032A) should be used and pin 6 connected to VCC giving a divide ratio of 128.

EXAMPLE:

8 MHz crystal installed, reference address divide ratio of 2048 is used. Prescaler divide ratio is set at 64. 1280 MHz oscillator output frequency desired.

8 MHz input divided by 2048 = 0.00390625 MHz.

0.00390625 MHz is our phase detect frequency.

1280 MHz divided by (64) = 20 MHz.

Then 20 MHz is divided by 0.00390625 MHz = 5120.

5120 = 4096 + 1024.

Inputs N12 and N10 should be connected to AGND. This is the opposite of the MC145106! The MC145151 has its input pins and reference address pins pulled up by internal resistors and are at positive voltage potential and inactive unless connected to ground. I guess these chips were done by two different groups—one group that preferred pull-down and the other group preferring pull-up. I have designed the artwork where a closed connection indicates the selection of that pin on the PLL to its active state. For those of you familiar with logic levels this will drive you nuts. Please remember the two PLL chips are opposite if you must use a voltmeter to troubleshoot your frequency keys.

Applying power

Do *not* power up the transmitter without connecting an antenna or dummy load to the output. This is a good practice to get into, even if the board would not be damaged. Antennas should be pointed away from organic life. Exposure to high-frequency energy can cause permanent damage, especially to eyes.

The board should be tested prior to installation of the high-power amplifier. The 50 mW section can be tested along with the rest of the board if your test equipment can survive the 50 mW as an input.

Connect board to power supply and verify correct voltages are being seen at all areas of the circuit. Check for hot parts: Under proper operation everything should be cool to the touch except the regulator (warm after 30 minutes) and the power amplifier (slowly warm to very warm after 30 minutes).

Troubleshooting

Most of the problems you'll encounter in building this board will be bad solder joints. The first thing to do is determine which section of the board is not functioning properly; make sure the power is turned off, and check all the solder joints in the section, touching up the joints that look suspicious. Reapply power and check to see if the section is now working. If power to that section is incorrect or the main regulator has the correct voltage on the "IN" side and no output there is a solder bridge somewhere on the board. Look for solder joints that have slopped onto their neighbors' pads or onto the power traces or ground planes.

Transmitter adjustments and alignments

Frequencies for video and audio are set by program keys and should be checked, the first time, anyway, to verify that you have understood the programming sequence. This is easily done using a spectrum analyzer with no video or audio inputs applied to the board, or a frequency counter can be used if it can be set to "peak detect" the signal. Audio frequencies can also be checked using an oscilloscope.

Video input level (VR300)

This potentiometer (pot) sets the deviation (the width) of the video signal. It should be adjusted with no signals applied to the audio inputs and VR101/VR201 set to minimum. Using a calibrated receiver (a receiver with known ATV characteristics and settings) the video input level should be set such that the video received is in color with no "bloom" (too much signal), or is not "dingy" (not enough signal). A spectrum analyzer will verify the total deviation at approximately 8 MHz. The *ARRL Radio Handbook* has suggestions on how to set video deviation.

Video mix level (VR101, VR201)

Subcarriers are a tradeoff. They rob power from the carrier—the video—to support their life. The adjustment of VR101/VR201 creates the balance between these two signals. Using a calibrated receiver, adjust until sound is heard clearly with no video damage. Play around; see what too much audio does to the video (tearing, lines of white dots), or not enough audio (I can't hear you, but you look great). Adjust the first subcarrier (the one closest to the carrier and lowest in frequency) first. If you are using the second subcarrier (most applications won't but it's there for stereo or controls) set it according to your receiver specifications for second subcarriers. Verify that the video signal remains good and audio is clear. The first subcarrier should be set approximately 10 dB down from the peak of the video signal and the second subcarrier approximately 10 dB down from the first subcarrier (this is a very good time to have a spectrum analyzer to visualize the relationship between signals). Bessel null calculations for subcarrier power levels and deviation in relation to carriers can also be used to determine empirically the best settings for each subcarrier.

Audio input levels (VR100, VR200)

The deviation of the audio signal should be set by (once again) using a calibrated receiver. This control with a normal IV p-p signal will be set "wide open." For audio levels above IV p-p, such as an amplified microphone, this control should be adjusted to bring the signal back to 1V p-p. "Hot" audio sources will cause the video to "tear" due to over-deviation of the audio signal.

Author's note: Boards, parts kits, and "mostly assembled" kits should be available by the time this article is published. Information on pricing and availability will be posted on the HATS Web page at [http://www.stevens.com/hats]. E-mail inquiries can be sent to [kc5awj@stevens.com] or [n5jxo@stevens.com]. Please send SASE for complete parts list.

Photo E. T-shirt and hat collection from activities supported by HATS since 1994. Not shown is shirt from 1994 Tenneco Marathon—it wore out.

Explorers, Adventurers, and Experts

How would you rule on this?

Henry B. Ruh KB9FO
3 N. Court Street
Crown Point IN 46307
[http://www.stevens.com/atvq]

Since October 1996, I have received notice from seven ham stores that have closed their doors. If this continues, we could be down to AES and HRO by the end of the year. Seventy-year stalwart Henry Radio in Los Angeles, home to Tempo rigs and the famous Henry line of HF amps (4K-2 and 6N2 and a 3004 currently reside in my shack) closed their doors. I spoke with Ted Henry, Sr., who remarked that it was not an easy decision, but there just weren't enough hams buying gear anymore.

Now that is in Los Angeles, the most ham-populated part of the country, with Jun's and several HRO stores still operating. All told, over twenty ham stores closed their doors in 1996 and the first few months of 1997. Everyone is citing a slowdown in ham buying. All the vendors are saying the "newbies" buy an HT or a mobile rig and that ends their ham radio activity. Few are getting into higher grade licenses, and even fewer are buying big HF rigs. I am told even many of the codeless techs are selling their gear and quitting ham radio.

There are almost no new Novice licenses being issued. Not surprising. Most higher grade licenses are upgrades from pre-no-code hams. How does this affect us? With fewer ham stores, there are fewer places to sell retail copies of ham magazines, and fewer places for people to discover ham radio. So ham radio is in a continuing downward spiral with no end in sight.

This is not a new phenomenon. Like those of us who have been around a while, I remember Doc's Radio Supply (W9HJS: Hairy, Juicy Sandwiches) on Milwaukee Avenue in Chicago, a few blocks from Howard Electronics, and a genuine junk shop. There you could buy hardware or parts by the pound. I bought my first SWL receiver at Doc's, an SX99, and later a 101A. As a kid I would take the bus to Allied Electronics on Western Avenue, home of Knight Kit (remember the R-55 and T-90?). On the east coast there was Lafayette Radio, on Jericho Turnpike on Long Island. And most of us remember Heathkit and the Benton Harbor lunch boxes! A chain of Olson stores sold parts in little bags: "Kit of three SW101 switches, 99¢!"

I worked in two of the stores while in high school, taking home a cool $100 a week (back when the minimum wage was $1.10) and getting a hefty 20% discount, which helped stock my test equipment and parts boxes. I had the time to build all sorts of neat stuff from the pages of *Electronics Illustrated, Popular Electronics,* and others. I remember building a 2m regen receiver (two tubes) and a four-tube (6AQ5 final), 160m AM Tx. Five amazing watts RF output into a random long wire! I used a car radio with a retuned LO for Rx and lots of other stuff.

I have sat and thought about how, in my ham life, I have purchased over 300 radios over the years. Most were from companies that no longer exist: National, Drake, Swan, SBE, Heath, Trio (now Kenwood), Hallicrafters, B&W, Multi-Eimac, Regency, Genave, Gonset, Hammarlund, Clegg, Polycom, Allied/Knight, Lafayette. The common thread among all of these rigs was that they were *fun* radios. You could put in various mods to make them "better" or extend their range. (The Clegg FM27 was originally a 1MHz-coverage 2m rig. Another Michigan ham and I modified them for two, and then later 4MHz of range! Imagine, going from an HR-2 6-channel rig, or a slew of modified Motorola/GE/RCA/Link stuff, to a rig that covered the whole band!) My, and others', early repeaters were usually modified stuff, Motorola G strips and Sensicon As, T-43GGVs, and T-44s. Back then, if you were in radio, you were in *your* radio ... a lot!

No wonder there is little time/incentive to play with ham radio. We're all tinkering with the Internet, Web pages, and URLs. So I got to thinking. Last October (1996), I filed a 14-page Petition for Rule Making with the FCC. No RM yet. What is it?

It's a proposal to change the nature of how we do ham radio licensing. Ham radio has changed severely. The old incentive for tinkering, building, and operating has mostly disappeared along with the ham stores, parts houses, Heathkits, and manufacturers. The time competitor for technical people is now the computer/Internet. Why struggle to make one contact in Hamburg with a couple grand worth of radios/antennas, when you can check into a chat room filled with people from Hamburg for the cost of a local call? But we still do things like WAS, DXCC, county hunters, fox hunters, and contests. There are still those who pound brass because they *want* to. There are still lots of nets and there are still the 2% of hams who experiment, build, tinker, and play with more than FM and SSB.

So let us change from a helter-skelter system of license classes which have little meaning for today's ham, to a more simple one that offers more and can offer accomplishment. No more boring tests, no more grinding out hundreds of hours of CW tapes. *Let's change from a test-oriented license system to an achievement-oriented license system.* Those familiar with Scouts or professional accreditation or pilot license requirements will recognize this idea right away. If you get *N* merit badges, you become an Eagle Scout. *N* hours and you are a private pilot; another series with an instructor and more hours and you get commercial/instrument; more experience and you qualify for ATP. Well, why not a ham radio version of "merit badges" ... WAS, WAZ, DXCC, etc.?

And what's with these names: Technician, Novice, Extra, General, Advanced? My proposal is based on three steps: Explorer, Adventurer, Expert. Who wouldn't want to claim to be a Ham Radio Expert, and has the FCC paper to prove it? Got your ego working yet?

The entry license, Explorer Class, would be just that. Explore ham radio. Not a few narrow CW bands, not just VHF/UHF FM, but the whole range. HF, VHF, UHF, microwave privileges, CW, SB, FM, video, spread spectrum, whatever turns your crank. Explore ham radio and find out what you *like* to do. Contests, DX, brass pounding, whatever. Not all the bands and privileges, but a good sampling, even on bands that work when the sunspots don't! A reasonable test on the rules, safety, and operating to get you going. Now you can do more than buy a 2m HT and act like a licensed CBer. Get on HF and work a little DX, do some OSCAR, fiddle with TV, SSTV, 160m. Get to experience a broad range of activities and areas to develop knowledge (self-learning) and experience. More than knowing the Q code for FM repeaters.

Now, along the way, earn your WAS, or a CW proficiency certificate, go to hamfests, and read some magazines. This is called continuing education. Take in a seminar from the local ham club on new rules or antenna/RF safety. Gain more knowledge. Have fun while you're at it. When you get enough points in "merit badges," turn in your chips and get the Adventurer Class license.

With Adventurer, you get full privileges and full power, only a few areas out of your realm. But now you can get DXCC, WAZ, 5-band WAS, work some major contests, write for magazines, maybe teach some new hams stuff, integrate your computer with your ham stuff, build a repeater, and enjoy the adventure of ham radio. Along the way, collect some QSL cards. After a while, you will have accumulated more "merit badges" to get to 400 points, and can turn in your chips for the ham radio Expert Class license. Now you are Mr. Know-It-All and have the wallpaper to prove it.

Your ham license actually stands for *accomplishment*. You actually *did* something besides study an ARRL Q&A license guide to upgrade. Your incentive to operate is based on your desire to do things, and to upgrade to a greater range of activities and interests becomes an outgrowth of your personal growth. No more one-trick ponies. You won't be able to brag that you got your Extra and never plugged in a soldering iron.

Now, this is not for everyone. So let's grandfather those who want to stay where they are. They can renew their current licenses until they die. We won't reduce their privileges as the ARRL Incentive Licensing system did. But you can't upgrade to another "old" license class. If you want to upgrade, it will be to a new license. Just meet the new criteria. In other words, get out there and *do* something. Get a feeling of accomplishment. Turn that county hunter certificate or SMIRK certificate or Sweepstakes score into something worthwhile: a higher-grade license/callsign.

The emphasis would be on *operating/learning/accomplishment* on the air. QSL cards will fill the mailboxes. Ham magazines will flourish with new readers and writers, who will want more and have a reason to buy/build more equipment, and the VEs will be busy checking certificates rather than test scores.

The point will be that there is a huge pool of activities that will accrue "points" toward your upgrade. If you want to pound brass, your 35 wpm ARRL certificate will count, if you don't choose another area ... high contest scores, author an article, get your DXCC, WAS, etc., work 3cm, or 160m, and get the QSLs to prove it. *You choose which criteria* you collect to get enough points to upgrade. There would be *no* mandatory areas except safety and regulations, which could be satisfied by attending a one day seminar at a ham club, hamfest, or community college. Your mailing labels for five years of ham magazines could be proof of continuing education.

Get the idea? We have to change the nature of ham radio to compete with other time interests. We can do that by encouraging *operating*, not book/brass study. Besides, operating is the *fun* part of ham radio anyway—so let's encourage it!

There is the question of who determines how many points or merit badges. Answer: the VEC joint committee. Each ham radio organization that wants its operating certificates considered submits the criteria for earning the certificate to the VECJC, which determines how many points it is worth.

Determined how, you ask? The whole point is that each "evidence" of operating has some value. The point value should be assigned by the difficulty and breadth of experience each represents. Thus a WAS has *X* value, a DXCC has *Y* value. There is always someone who will raise the question, "I got my WAS by using a voltaic pile and a frog's leg to work the key, so it should be worth more." Well, you had better have the frog's leg and there had better be calluses on it that match the knob of the key! Sorry, but just because you could create a unique circumstance in which to achieve the WAS (or whatever), you don't give it any additional value.

However, if the WAS was for 50 states on only 2m and only from OSCAR, versus a bunch of HF contacts on four bands with some 6m and 2m stuff thrown in, there is a difference. The first gets the plain vanilla five points, the second gets seven or eight. Why? Because the first represents only one operating mode, and patience. The second represents (likely) several modes and several propagation experiences and therefore has more breadth to it. It gets the extra points because of the additional modes and propagation methods: five points for WAS, and two to three of the five points for operating seven or more bands, or for working seven or more modes. Keep in mind this is just an illustration, not necessarily the final say-so on how many points for any particular operation. The VEs can design the system and select what and how much.

Now, some may comment negatively that this "forces you to do things." Not any more than the rules now "force" you to study like crazy to upgrade. The difference is that with the new system you would choose a menu of activities that interests *you*. There would be no mandatory areas except safety. And, as now, if you do not want to work CW, you would not have to—you could do any of the other menu items possible to demonstrate achievement and personal growth.

If you don't want to grow, then don't do anything! If you don't want to upgrade, you don't have to. But why did you get into ham radio if you are not going to get involved in many areas and experience new things? Isn't that the main purpose of ham radio, to improve the knowledge of the license holder?

WIIFM?

If we are all operating more, it should be more fun for all of us. If more participate in any area of ham radio, that should make that area more fun. If we all learn more and experiment more, who knows where that will lead!

Maybe some of us will be inspired enough to buy a new radio, maybe some will buy a new antenna, or dare I say ... home-brew a rig or antenna! Maybe WAS or WAZ will be more exciting if there is more than one active ham in a county, zone, or state on a particular band. It's amazing how 6m will open from the midwest to Mobile, Alabama, and yet there'll be not one signal from Pensacola, Florida! Maybe more active hams will get 6m, or 220, or 1296, active on more than contest days!

Maybe the packet users will finally start using high speed time multiplex backbone links! Maybe trunking or other modern communication systems will arrive.

Or even still, maybe one ham will finally work his 50th state and qualify for WAS. Maybe there would be enough interest that clubs would begin to grow! And lastly, maybe there would be enough interest that a ham store could stay in business in Chicago! And instead of scrawny ham magazines with 50% filler and 50% ads, we would have 300+-page issues as they do in Japan, filled with lots of interesting things to do, to build, to enjoy!

We need to do one more thing—and we have already started. There are a lot of ham Web pages on the Internet. These are great starting places for those who stumble over them. Let's do it one better. Let's tie the ham Web pages to each other (as some have) and let's advertise, on the Web and elsewhere, the *fun* stuff of ham radio ... not, "The Tennessee Valley Indians Home page is located at HTTP:\\www.TVI.com," but put key words in the title so search engines *find* us. How about Rare Contact With Aliens (DX), Interactive Television (SSTV and ATV), Antique Radios (tube rigs etc.), Radical Rabbit Ears (antennas), Cure Spectrum Spreading ...

Get your imagination going and let's introduce ham radio to those who are looking for the next challenge. And yes, you can tie the Internet into your local repeater so that you can HT from LA to London to Sydney. Do it with video, too!

Here is my petition. It proposes to reduce the number of license classes to three, to be called Explorer, Adventurer and Expert. It proposes to grandfather all existing licensees' privileges, to allow a phase-in of the new licenses and privileges; it proposes allowing those holding a current amateur radio service license to either continue their present class and privileges or to adopt, through meeting the criteria listed for each, a new license class and privilege set. This petition proposes the continuation of the Volunteer Examination system so as to not add to the Commission's administrative burden.

Basis for changes

It has long been held by a great many hams and non-hams that the incentive licensing structure, initiated by the ARRL and implemented in the rules more than three decades ago, has not achieved its intended purpose; it is often blamed for the demise of manufacturers and electronics stores from the outflows of hams and the failure to attract new hams. The system depends on the individual passing a series of exams in order to attain a higher class license and more extensive operating privileges. The system also failed to recognize, at the time of implementation, the license status and privileges of existing license holders, and removed privileges from certain license classes, sparking ire and debate which lasts to this day.

The Commission currently issues licenses based upon examination. These exams serve as a gateway and include questions for which the individual cannot have prior experience to gain the knowledge, but must rely on Q&A license books and classes. The use of memorizable Q&A books such as those published by the ARRL, Bash, Ameco, and others created controversy and debate. Later, other learning aids were published which provided text presentations to teach actual theory of operation, rules and technical topics. However, the exams can still be passed by simple rote memorization of Q & A guides.

The incentive licensing system was also supposed to encourage the individual to achieve a higher class of license. When the number of individuals attempting to upgrade was disappointing, additional incentives were added, to wit: "better" callsigns (i.e., a 2x2 vs. a 2x3), vanity callsigns (for Extra class or for those with 25 years or more).

The fatal flaw in this system is that the individual has little direct knowledge of what the additional privileges may offer, since the individual is prohibited from operating certain modes and certain bands until the effort to learn from class and exam stage is passed. There is also lack of value to each level of the license structure since each level can be accomplished by only passing an exam of rote knowledge and makes no effort to encourage operation and learning by doing, which would add intrinsic value. I would compare this to telling a person

that strawberries and asparagus are both equally delicious, but that they cannot have either until they first pass an exam on fruits and vegetables, and the exam only covers the biological necessities for growing them. The value of the goal is unknown, and therefore the value of the effort to pass the test is unknown. Until you taste strawberries and asparagus you can't judge the value and personal desire to have more.

Further, although there has been an influx in new license holders, few of these are expanding their horizons into other areas of ham radio, i.e., upgrading, to become more proficient and knowledgeable. Indeed, we might say we have created a handie-talkie generation, with little incentive to go beyond the use of the local narrowband FM repeater usage to discover the many other areas which offer fun, rewarding experiences, personal growth and achievements.

The basis for the proposed license system is experience and achievement. Only an initial written exam is required; although a written exam in certain areas is retained, it is replaced in most part by technical knowledge and operating experience with some credit for continuing education. The incentives are expanded privilege and callsigns of choice, but with the added value that the license and callsign stand for actual *achievement*, not memorization of a Q&A book. The exam portion would cover only those areas where experience cannot be easily obtained, such as electrical and RF safety, to minimize the risk of dealing with these everyday hazards. If the saying, "Experience is the best teacher" is true, then we need to encourage experience, through encouragement of operation and building, and related means, to achieve the goals of the basis and purpose of amateur radio, to provide a pool of technically competent individuals, to encourage education and good operating skills.

License specifics: the Explorer class license

The purpose of this license is to allow the individual sufficient operating privileges to get a sampling of nearly all areas of ham radio, vs. the narrowly-defined experiences possible as a Novice or Technician or Technician-plus license holder. By experiencing a larger variety of operating modes and bands than those allowed the Novice and Technician class holder, the Explorer license holder would be able to achieve a much higher level of understanding, new interests, and self-motivation to go farther in the hobby. The tangible rewards would be certificates of achievement in various areas, meaningful personal value to the license held, and callsign and additional operating privileges for completion of the license requirements.

The Adventurer class license

The purpose is to allow the individual additional operating mode and band privileges in order to achieve proficiency in all modes and all propagation conditions experienced in ham radio. The class could be compared to the General and Advanced class of license, wherein the holder accesses all modes and all bands, albeit not all frequencies on all bands. The tangible rewards would be certificates of achievement in various areas, value of the license held (since it stands for achievement, not Q&A test passing) and additional operational privileges for completion of the license requirements.

The Expert class license

This would represent the highest level of operating achievement and experience. It would encompass all bands, modes and frequencies as the Extra class license now does. A person could not, as I have heard some Extra class holders brag, "Get an Extra without ever touching a soldering iron." The requirements include both operating achievement and technical experience. The tangible rewards include certificates of achievement, preferential callsigns, and full operating privileges.

Examinations and procedures

The examination process would cover only those areas for which direct experience would be an issue of public safety and interference with other services or within the amateur service. The additional license requirements are all based upon completion of experience and operating elements. These other elements cannot be achieved through a Q&A book, as they require actual on-air operation and validation and technical

achievement, achievable only through activities that are related to, but not a part of, direct on-air communication. It is the emphasis on *experience*, not rote knowledge, that makes this license system different from the current license system. Further, in order to accommodate some variation in interests and opportunity posed by personal ability, location, or other circumstances, the list of license requirements is much like a college degree program, where there are mandatory areas and optional areas.

The list of achievements provided herein is not meant to be all-inclusive nor exclusive. It is intended to be representative, and not either final nor prejudicial toward options which may be suggested by others who might comment on this proposal.

Examination and validation of the experiential portion of the license would follow the general VEC program in existence today. Individuals wanting to upgrade would present their proofs of achievement to a VEC, which would verify the achievement, and pass/fail grade the application. It would then follow the current procedures for grant and issuance of a license and callsign.

Recognizing that some individuals may have preference for different areas of concentration of their interests, or may be limited by physical constraints, the license requirements should be balanced so that a higher license grade can be achieved through the reasonable attempts of the applicant. Further, sufficient time is allowed to compensate for individual lifestyle circumstances, and other real-life concerns which can affect opportunity and ability to achieve, and yet still allow the realization of the goals of both national interest and individual interest.

For example, it would be unreasonable to require a person to operate on 160 meters, since many people cannot erect a suitable antenna because of urban living quarters, but could operate the 3cm band due to close proximity of other hams, whereas a rural resident who can operate on 160 meters could gain achievement and experience on this band, yet not be able to operate on the 3cm band because of lack of nearby population. This is not to say that the urban person cannot operate 160, it would simply be more difficult, or require more than a reasonable attempt to do so. Likewise, the rural resident could operate 3cm, by portable or mobile operation in a more populated area, but would it be reasonable for a person living in a remote part of Alaska to do so?

The individual would choose, from the selection, those items that s/he feels s/he can achieve in a reasonable manner, as defined by the individual, and present the summary of achievements to meet the criteria for upgrading.

License criteria

The purpose of graduated license classes is to ensure public and private safety, compliance with the Commission's rules, and, to some extent, differentiate between various levels of expertise, rewarding those having earned additional expertise with additional privileges.

Since the goal of public and personal safety, compliance with rules, and not causing interference is applicable to any licensed operation, it can be met at the initial stage of license. Therefore it is proposed that a question pool, as currently used, be adopted, with areas of topics which address the following:

Electrical safety: Harmful or lethal aspects of electricity; safety procedures; interlocks; discharge of power supplies; disconnection of devices; harmful or lethal aspects of RF and microwave energy (non-ionizing radiation); standards of exposure; harmful or lethal aspects of antennas and erection; controlled and uncontrolled environments; hazards of portable and mobile operation. Interference with other devices (pacemakers) and other areas may be suggested.

Compliance examples: Frequencies allocated and allowed; modes of transmission; technical consideration of modulation in various modes (spurs, artifacts of overmodulation/deviation); interference avoidance and other areas currently examined or as may be suggested by others. This is currently addressed by the question pool, but may need to be expanded in topical areas.

Operational examples: Since some knowledge of operating practices and courtesy is necessary before operation, a question pool which covers this area is necessary, to avoid inadvertent interference with established communication patterns and conventions, and allow acclimation to and acceptance by current operators and operations. Currently the question pools include specific operating methods and techniques for CW, SSB, HF, VHF, packet, digital and visual modes, band plans and repeater operations of voice and non-voice signals.

The remainder of the license criteria would be met by certificate of achievement in various areas. Since the initial license applicant cannot have prior experience, only the written portion of the exam would be required, as it is now for the Technician class license. The Adventurer and Expert class upgrades would only require proof of achievement in various areas, and a refresher course (review).

License privileges

The license holder must have opportunity to achieve growth and experience in a broad list of categories, allowing the ham to attain the necessary knowledge and skills for the next higher level. To meet this goal the following list of privileges is proposed for each of the three classes of license. Achievement of proficiency in each area (and alternate areas discussed later) is used to gain a higher license.

Explorer class license privileges

•Callsign: 2x3, 3x3, or 3x4 format or distinctive prefix (e.g., WN, WNN, NAA, etc.).

•CW operation on subbands of 80, 40, 30, 15, 10m.

•SSB operation on 25kHz of 2 HF bands, 40 and 15m (or those selected by commenters or the Commission).

•SSB operation on subband of 13cm, and all frequencies on 9cm and above.

•SSTV operation on 50kHz of the 10m band and on VHF frequencies allowed (below).

•FM voice operation on 2m above 146.00MHz, all of 1-1/4 meters, 33cm and above 9cm.

•Video operation on 13cm and 23cm or above.

•Digital operations on subbands (packet, RTTY, etc.) 6m, on 1-1/4 meters, and 13 cm and above.

•Spread spectrum operation on 13cm and above.

•May not be a repeater owner/operator/trustee (may use a repeater, but not be a control operator).

•May *not* be VE.

This allows exposure to all general-use modes, access to all propagation modes, and operating circumstances of HF, VHF, UHF and microwave.

License term: 10 years, renewable once for an additional five years. This provides a reasonable time for achievement of proficiency and experience to meet the criteria for the next class of license (below) in a controlled environment, where interference potential is minimized. Enough contact is allowed with higher class licensees on various bands and modes to gain knowledge from experience, yet the license is restrictive enough to encourage a desire for more privileges.

Adventurer class license privileges

Experience in most areas having been achieved, this class license would allow full privileges in all bands and all modes except for those reserved for Expert class. It follows the general concepts of the current General and Advanced class license.

•Modes: all currently permitted by General/Advanced class.

•Frequencies: all currently permitted by General/Advanced class.

•May build/operate/trustee repeaters.

•May serve as VE.

•Callsign pool: same as current Advanced class.

•License term: 20 years, renewal once for additional 20 years.

[Note: Petitioner is not opposed to lifetime or other term periods. However, 40 years should be more than enough to cover the life span of interest or achieve the criteria for the next higher (Expert) license class. The goal is to have all hams at the Expert level after a reasonable time period. With 15 years at Explorer and 40 at Adventurer, this allows 55 years to achieve the highest level. Starting at age 10, age 65 should be considered reasonable. For those who simply have no desire to enrich themselves, we may decide to either continue to renew, or *require* advancement. This is an area sure to draw comments.]

Expert class license privileges

•Modes: all.

•Frequencies: all.

•May build/operate/trustee repeaters.

•May serve as VE.

•Callsign pool: same as current Extra.

•License term: life.

License criteria

This proposed license system encourages learning through experience, and is presented as a guide for specific criteria of achievement.

Achievement can be demonstrated in several ways. Passing an exam is the traditional method, but this can be done by rote memorization of questions and responses. In order to encourage operating and life experience as tools for learning and development, the criteria for a license should be based upon *doing*, rather than testing. There are a number of recognizable operating achievements today. These include certificates for WAS (worked all states), DXCC (worked 100 countries), or for various contact multiples, i.e., certificates for having worked X number of stations in a particular mode or particular band. It is proposed that these certificates, issued by bonafide amateur radio publications and organizations, form the basis for the license upgrade criteria. Since there are numerous areas of interest and opportunity, it is proposed that all the applicable operating awards be seen as a pool. Achievement of a certain combination or "points" assigned to each certificate would constitute proof of operating proficiency. In addition, points could be awarded for certain ham-related activities, which prove knowledge or exposure to information. These additional areas include such activities as having a technical article published, writing a computer program, building/publishing information on equipment, operating during specific events such as Field Day, or VHF contests (log submissions). Participating in public demonstrations using portable/mobile equipment, CW speed and accuracy certificates, participation in public service, attendance and completion of various ham classes as may be established by the VEC or other educational enterprises. Other criteria as well may be established.

The criteria for each license are to be based upon a point system. Passage of an exam may be a part of the overall point pool, and could be a substitute for some but not most of the experience criteria.

Criteria pool

The following list is not to be considered all-inclusive or -exclusive. This list should not be considered an endorsement. nor absence from this list be considered a lack of endorsement of any organization, publication or group. These were chosen simply as widely recognized examples, or icons of the type of achievements to be considered in this proposed license system.

Explorer class license criteria

Passing an exam of 100 questions, with a grade of 70 or more, covering all aspects of ham radio currently covered by the Novice and Technician question pools, with 10 questions in each of the following required areas.

One point for each correct answer:
Public safety, Personal safety, Antenna safety, RF safety, Interference, Regulations, VHF operating, HF operating, FCC regulations, General electronics knowledge.

Five points:
Subscription to at least two ham radio magazines, one of general interest and one of specialized interest.

70 or more points is a passing grade.
Verification by VE: correct answers of the exam questions; subscription labels from publications.

[Note how this implies that the person will gain knowledge from reading about ham activity/construction, etc., as a substitute for a small portion of the necessary exam points. Thus the license holder is exposed to educational material on an immediate and continuing basis (a magazine subscription) and allows for credit for this exposure (in part) towards successfully meeting the criteria (70 points) to obtain the license. This also places some emphasis on classroom or learned rote Q&A and some emphasis on personal experience which meets the stated goals.]

***Renewal criteria:* achievement of 70% or more of the next license class.**

This is to ensure that earnest effort is made towards a higher class license, but that effort may have been limited by personal circumstance, too varied to be considered individually (i.e.. military service, family obligations, illness, etc.). Presentation of any combination of criteria to achieve 70% of the passing criteria—70% of 70%, roughly 50% of the next level's exam—would be evidence that effort had been made and an extension would be reasonable.

The time period selected, 10 years, should be considered reasonable; it is the same as current license periods.

Adventurer class license criteria

The entry level license proposed allows experience to be gained in all major areas of ham radio and operating experience in nearly all modes of modulation and under all major propagation methods. It is therefore proposed that the following pool of criteria be used to achieve the next level of license and privileges. Again, I wish to emphasize that the criteria listed are recognizable icons, and are not an endorsement of nor a prejudice for or against any organization or publication.

HF Operation:

Possible criteria and possible verification method by VE. Verification methods are not repeated to avoid redundancy.

20 points for any of the following (minimum 2, 40 points):

•Proof of 2000 contacts on a minimum of six HF bands using a minimum of CW, SSB and a third mode (QSLs).
•Holder of WAS certificate.
•Holder of DXCC certificate.
•Holder of WAZ certificate.
•Placed among top 100 in major HF contest (sponsor's published list).
•Operated Field Day with more than 500 contacts (QSLs).
•Operated portable or mobile with 100 or more verified contacts (QSLs).
•Holder of other recognized HF certificate of achievement equivalent to above.

VHF/UHF/Microwave Operation:
20 points for any of the following (minimum 2, 40 points):

•Proof of 2,000 contacts on at least four bands above 50MHz, using a minimum of four modulation modes.
•Worked 30 or more states on VHF or above.
•Worked 30 or more countries on VHF or above.
•Placed among top 100 in major VHF and above contest.
•Operated Field Day with more than 250 contacts on VHF and above.
•Operated portable or mobile with 100 or more verified contacts.
•Holder of other recognized VHF and above certificate equivalent to above.

Operating Proficiency:
10 points: CW speed in excess of 20 wpm.
10 points: More than 200 countries worked using not fewer than 4 HF and 1 VHF band(s).
10 points: Publication of operating article in any recognized ham publication.
10 points: Publication of a technical article (or computer program) in any recognized ham publication.
10 points: Publication of a build-it project in any recognized ham publication.
10 points: Any recognized certificate of operating proficiency.

General experience and knowledge:
Modes: Proof of operation in each of the following:
20 points:
Each 25 or more verifiable contacts in each of the following modes (5 points per mode, minimum 4 modes):
•OSCAR
•ATV
•Packet or other digital mode
•RTTY (FSK/AFSK)
•SSTV
•FAX
•VHF DX greater than 250 miles (any mode, no repeater operation) (50-1000MHz)
•VHF DX greater than 100 miles (any mode, no repeater operation) (above 1000MHz)

Extended areas:
5 points: Subscription to two or more general interest and two or more special interest ham radio publications (publications may be foreign or domestic) for 2 or more years each (continuing education).
5 points: Instructor of a ham radio class, more than 25 total sessions (club newsletter, copy of signature on VE exams).
5 points: Featured in a public service story in any recognized publication (as the person doing the public service).

5 points: Regular participation in SkyWarn or similar activity (letter from net control).

5 points: Regular participation in ham club activities (officer, director, committee person, club newsletter).

5 points: Attendance at 25 or more hamfests or 20 or more ARRL state or national conventions (ticket stubs).

5 points: Certified VE.

2 points: Repeater trustee (holder of repeater license).

5 points: Attendance and completion of a ham radio safety refresher course.

10 points: Staff member or office holder in a national ham radio publication or organization.

Passing criteria: Minimums:

40 points HF

40 points VHF

30 points Operating Proficiency

40 points General Experience and Knowledge

Expert class license criteria

This license class represents the highest standard of ham radio operation. The person holding this should be knowledgeable in nearly all areas of ham radio, and be recognized as a leader.

HF Operation:

Possible criteria and possible verification method by VE. Verification methods are not repeated to avoid redundancy.

20 points for any of the following (minimum 5):

•Proof of 2,000 contacts on a minimum of 6 HF bands using a minimum of CW, SSB and a third mode (QSLs).

•Holder of WAS certificate.

•Holder of DXCC certificate.

•Holder of WAZ certificate.

•Placed among top 100 in major HF contest (sponsor's published list).

•Operated Field Day with more than 500 contacts (QSLs).

•Operated portable or mobile with 100 or more verified contacts (QSLs).

•Holder of other recognized HF certificate of achievement equivalent to above.

VHF/UHF/Microwave Operation:

20 points for any of the following (minimum 5):

•Proof of 2,000 contacts on at least 4 bands above 50MHz, using a minimum of four modulation modes.

•Worked 30 or more states on VHF or above.

•Worked 30 or more countries on VHF or above.

•Placed among top 100 in major VHF and above contest.

•Operated Field Day with more than 250 contacts on VHF and above.

•Operated portable or mobile with 100 or more verified contacts.

•Holder of other recognized VHF and above certificate equivalent to above.

Operating Proficiency (minimum 4):

10 points: CW speed in excess of 30 wpm.

10 points: More than 200 countries worked using not fewer than 4 HF and 1 VHF band(s).

10 points: Publication of operating article in any recognized ham publication.

10 points: Publication of a technical article (may be a computer program) in any recognized ham publication.

10 points: Publication of a build-it project in any recognized ham publication.

10 points: Any recognized certificate of significant operating proficiency (e.g., DXCC honor roll, top 25 in a major HF or VHF contest).

General experience and knowledge:

Modes: Proof of operation in each of the following modes:

30 points each 100 or more verifiable contacts in each mode (5 points per mode, minimum 6 modes):

•OSCAR

•ATV

•Packet or other digital mode

•RTTY (FSK/AFSK)

•SSTV

•FAX

•VHF DX greater than 250 miles (any mode no repeater operation) (50-1000MHz)

•VHF DX greater than 100 miles (any mode, no repeater operation) (above 1000MHz)

Extended areas (minimum 45 points):

5 points: Subscription to two or more general interest and two or more special interest ham radio publications (publications may be foreign or domestic) for 5 or more years each.

15 points: Instructor of a ham radio class, more than 25 total sessions. (club newsletter, copy of signature on VE exams).

5 points: Featured in a public service story in any recognized publication (as the person doing the public service).

5 points: Regular participation in Sky Warn or similar activity (letter from net control).

5 points: Regular participation in ham club activities (officer, director, committee person) (club newsletter).

5 points: Attendance at 50 or more hamfests or 25 or more ARRL state or national conventions (ticket stubs).

15 points: Certified VE.

5 points: Attendance at and completion of a ham radio safety refresher course.

10 points: Regular instruction of a ham radio safety course.

10 points: Editorial staff member or office holder in a national ham radio publication or organization.

5 points: Editor for 1 year or more, club newsletter or special interest newsletter.

5 points: Club or national officer or official 1 or more years.

Passing criteria:

100 points HF

100 points VHF

40 points Operating Proficiency

30 points General Experience and Knowledge

45 points Extended areas

VE role

To eliminate added administrative load for the Commission, the license application would follow the current VE system. Applicant's license application certificates (proof of experience) would be examined by the local VE committee. In the event of a dispute over the value or validity, the VE decision would be arbitrated by the sponsoring VE organization. Guidelines listing the multitude of certificates available as "recognized" would be generated by the sponsoring VE groups, who would agree to not exclude or include certificates, on the basis of issuing organizations to which they are affiliated which are not so recognized by the other sponsoring VE groups. [For example: A certificate from the ARRL, which is recognized by ARRL for license purposes, could not be rejected by others; likewise, certificates recognized by other VE sponsors could not be rejected by ARRL VEs.]

Any non-certificate sponsor may apply to a sponsoring VE group to be recognized, or may be presented by the applicant for consideration by the VEs.

Verification of operational criteria, through the use of QSL cards or letters confirming contacts, shall be limited to the existence and possession of the QSL card. Published lists of contest participants and their scores shall be verification of such criteria. Other publications may be used to verify other criteria, such as class attendance logs, ticket stubs bearing name and call letters and an attendance stamp from the sponsoring group, as is used by professional organizations to verify participation and attendance for professional certification.

Any dispute not so resolved would be presented to the FCC for final resolution as a simple ALJ administrative matter.

Again keep in mind that the criteria listed here are not all inclusive nor meant to serve as anything more than to illustrate how the license system would be based upon experience and achievement, rather than simple test memorization.

Specific rules changes requested:

The specific rules changes to implement the proposed license system are as follows:

1. There shall be a grandfathering and continuation of all present license holders of all privileges and licenses currently held, until such time as the licensee expires, upgrades to a new license grade of the new series, or the license is otherwise expired, terminated or revoked.

2. There shall be, as of the effective date of these rules, three classes of license for the Amateur Radio Service. The classes of license shall be: Explorer, Adventurer, Expert.

3. The VEC sponsoring shall select and establish exam and certification criteria, based upon the concept of learned knowledge and operating experience. Such selection criteria shall be made without regard to the sponsoring organization established certification processes.

The license criteria for the Explorer class license shall be:

Passing an exam of 100 questions, with a grade of 70 or more, covering all aspects of ham radio currently covered by the Novice and Technician question pools, with 10 questions in each of the following required areas.

One point for each correct answer:

Public safety, Personal safety, Antenna safety, RF safety, Interference, Regulations, VHF operating, HF operating, FCC regulations, General electronics knowledge.

Five points:

Subscription to at least two ham radio magazines, one of general interest and one of specialized interest.

Achievement of 70 or more points is a passing grade.

The license criteria for the Adventurer class license shall be:

The accumulation of points necessary to achieve the proof of experience necessary to ensure understanding of HF, VHF, general electronic knowledge of safety, HF and VHF operation, and the technical parameters of the various modulation modes permitted to the amateur radio service, to allow operation without undue risk to public or personal safety and unreasonable interference to other users and modes. The VEC sponsoring organizations will select, define and decide those criteria necessary to meet this goal.

The license criteria for the Expert class license shall be:

The accumulation of points necessary to achieve the proof of experience necessary to ensure understanding of all propagation modes, all rules, regulations and operating criteria, all modulation technical consideration, and continued sponsorship of education of lesser licensees and public safety and service.

The Commission will adopt as specific rules those certifications, and proofs selected by the VECs which meet the goals and criteria for each license class.

In addition, the FCC will institute the licensing of all existing repeater stations with a distinctive callsign to ensure that such repeaters are sponsored, built and operated by the appropriate class licensee.

No new licenses will be granted in the classes: Novice, Technician, General, Advanced, or Extra, after the new license system begins. Each such class of

license shall expire completely when the last valid license currently held expires, including such renewals as may be granted for the existing license holder.

Other changes will be made as necessary for the adoption of the new system of license.

The license class names were also chosen for appeal, and to be descriptive of the privileges allowed. Explorer certainly sounds more impressive than Novice or Code-free Technician, and points to the license holder being allowed to explore ham radio in many areas. Likewise Adventurer was chosen, as the privileges allow many adventures in ham radio, and it sounds better than General or Advanced. Expert is more descriptive than Extra, and denotes superior knowledge and experience. 73

About the Author

Henry Ruh KB9FO has been licensed since 1969, and has been active on all bands and all modes 160-10GHz; served as a ham club president; produced and distributed PSAs on radio and TV to promote ham radio; appeared on many radio and TV programs to promote ham radio; testified before and successfully petitioned the FCC to change rules; built/operated repeaters on several bands and multiple modes; DXed on HF, VHF, and UHF; authored articles in every ham magazine; participated in and served as executive secretary of the ham radio working group for 1980 WARC; and allowed hamfests to be held on his own farm. He has received numerous achievement and public service awards for ham radio; operates from his home, car, and plane; has provided ham classes on his own broadcast radio station, and lots more. He is the Director of Engineering for a network-owned Chicago TV station and has over 30 years in broadcasting.

The New Emergency Alert System

Don't tune out that emergency broadcast test just because the Cold War's over!

Steven B. Johnston WD8DAS
3350 Oakham Drive
York PA 17402
[johnston@blazenet.net]

In 1994, the Federal Communications Commission finalized the characteristics of a communications system to replace the Emergency Broadcast System. This system, known as the Emergency Alert System, offers improved reliability and increased message capability. In 1995, the EAS began to be phased into operation.

Head for the bomb shelter, kids!

In 1951, President Truman established CONELRAD (Control of Electromagnetic Radiation) as the first national emergency alerting system. CONELRAD required AM broadcast stations to switch to 640 or 1240 kHz during an emergency alert to prevent enemy missiles and bombers from using their signals as target homing beacons. To activate CONELRAD alert receivers, the stations turned their transmitters on and off. CONELRAD was intended as an important part of civil defense in case of national-level emergencies such as enemy attack.

In 1963, President Kennedy established the Emergency Broadcast System (EBS) and allowed stations to remain on their assigned frequencies during a national emergency. The late 1960s and early '70s saw the development of a two-tone audio alert signal to replace the CONELRAD on/off signals. In 1976, the FCC, FEMA, and NOAA/NWS endorsed the use of EBS in state and local emergencies as well, opening the way for an alert system for severe weather and other regional emergencies.

The Emergency Broadcast System

The EBS was an analog transmission system. In tests and activations, an audible, 22-second-long, two-tone signal was used to catch the listener's ear, as well as trigger special alert receivers in broadcast stations, hospitals, schools, or any other sensitive locations. The tones were followed by a voice announcement of the test, or the nature of the emergency, what locations were affected, and instructions for the public.

EBS radio and TV stations were grouped by geographical region, and linked together to form a chain of stations. For example, a station in a state capital was designated the primary station for its region, as well as feeding the key stations in other regions, which in turn fed the stations in their areas. Emergency Broadcast System equipment was manually tested on the air once a week by individual stations, and the chains of stations were tested together periodically (timing varies according to state plans). Activations of the EBS for emergencies could be requested by local officials, the National Weather Service, station personnel, or other designated sources. The request arrived by teletype, telephone, two-way radio, or via the "daisy chain" of broadcast stations.

The EBS had several drawbacks. The system relied on each broadcaster's conscientiousness to alert the next station in the chain. If a station operator decided to forget about it, or the equipment failed, the next station down the chain did not receive the alert message and could not inform their listeners or the other stations.

Even when EBS worked properly, the length of time for a message to travel the chain could result in an announcement too late to be helpful to the public. In addition, the lengthy two-tone signals used for weekly tests desensitized the public—they often tuned to another station

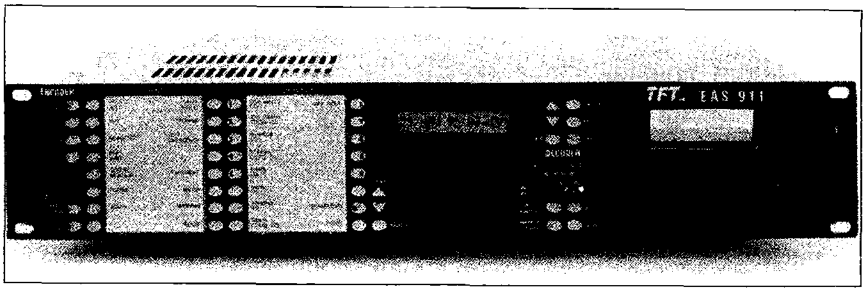


Photo A. EAS equipment can be programmed to sort, display, print, or forward messages based on the header codes.

when the long tone was heard, thinking it was just another test.

The New Emergency Alert System

The FCC determined the characteristics of an improved replacement for EBS called the Emergency Alert System (EAS). This new system combines digital and analog technologies to meet the goals of greater reliability, increased listener attentiveness, and timely delivery. It will also bring the cable TV industry into the emergency alerting field.

An EAS emergency message consists of a digital signal header, a shortened two-tone EBS-style signal, an analog or digital message, and an end-of-message (EOM) signal. The means of linking emergency operation centers, broadcast stations, etc., is completely flexible, and includes the ability to interconnect the facilities using a "web" topology rather than a "daisy-chain" for greater reliability.

The digital signal is compatible with the National Weather Service WRSAME (Weather Radio Specific Area Message Encoding) system. Individual EAS sites will be tested unobtrusively each week by sending just the digital headers and EOM. Coordinated monthly tests (and activations) will consist of the headers, the two-tone signal, a voice or data message, and the EOM.

The messages can arrive by radio, telephone, TV, cable, dedicated circuit, or any other means that can pass a voice-grade signal. Each broadcast facility will be required to monitor at least two outside sources of EAS messages, forming a web to increase the chances of messages reaching their targets. A typical installation might have receivers listening to two broadcast stations, a link from the county emergency operations center, and a National Weather Service receiver.

EAS data transmissions are compatible with the National Weather Service's WRSAME system. Audio frequency-shift keying at a rate of about 520 bits per second is used, with mark at 2083.3 Hz and space at 1562.5 Hz. The content of the messages will seem rather cryptic to a monitor looking at the raw data, as they consist of an assync-preamble and ZCZC, followed by numerical codes that refer to lookup tables of originators, identifiers, event types, locations, etc. In addition, the messages are time stamped and conclude with the End-of-Message code NNNN.

EAS equipment can be programmed to sort, display, print, or forward messages based on the header codes. Stations can preset their decoders for certain types of emergencies (for example: Ignore tornado watches, accept tornado warnings), accept emergencies that apply to their coverage area, and automatically or manually put an alert on the air.

To catch the ears of listeners, the headers will be followed with the shortened two-tone EBS signal for eight seconds, then a voice message detailing the emergency for listeners. Automated stations will appreciate the End-of-Message code NNNN which can be used to trigger the next event on their station's playlist.

EAS today and tomorrow

The first steps to EAS implementation took place in 1995: The existing EBS tone encoders and decoders were modified for the shorter, eight-second, two-tone signal. In addition, many broadcasters adopted a new script for the shortened tests, which explained that a new system was on the way.

EAS equipment specifications were finalized and EAS equipment was brought to market in early 1996. The equipment is a mixture of dedicated hardware and PC-based systems. By mid- to late 1996, stations and emergency centers were buying and installing the equipment (although some inventory shortages caused late installations). Meanwhile, state and local area EAS plans to incorporate the improvements offered by EAS should have been designed, written, and accepted. The FCC deadline for full EAS operation at broadcast stations was January 1, 1997.

Holiday of a Lifetime

Ham friends are lifelong friends—even if you're meeting them for the first time!

Roger J. Cooke G3LDI
The Old Nursery, The Drift
Swardeston, Norwich
Norfolk NR14 8LQ
UK

Recently, I was made redundant from work after 31 years as a TV/video engineer. As I was into my fifties, considered a "wrinkly" by the younger generation, and an "Old G3" by the young G7s, I looked at the employment market and promptly took early retirement.

As a result of being active on the HF bands for over 35 years, I had made lots of friends all over the world. Some had visited the UK and stayed with me in previous years and had asked that I visit them at some stage. This I had done a few years ago, when I visited friends in the USA and Canada. In 1993, I had friends from Victoria, Canada, Fred Wyatt VE7PL and his wife Jean, staying at my place again.

This was the week of our annual Norfolk AX25 Group barbecue. Also present at that barbecue was another old friend, John Bays VK2SB and his wife Mary. John used to live in Ipswich, Suffolk, and I knew him when he was G3KFX. He has been in Australia for 27 years now. During a conversation, it was suggested that I come over to Canada to visit with Fred. John also suggested that perhaps I should visit Australia. I did not take this very seriously at first, but during subsequent conversations on the air the whole trip slowly began to take shape in my mind.

I was also in contact with more friends in the USA, one of whom was my HF packet-forwarding partner, Tom Abernethy WA3TAI, from Accokeek, Maryland. He wanted me to visit with him and drive up to Dayton for the HamVention. At the same time, I was also keeping skeds with Dick Bendicksen N7ZL on OSCAR 13. Dick lives in Seattle and told me that I was not to leave him out of the schedule. The same statement was made by another friend who had stayed with me several years ago, Dave Snape VE7IM.

By this time, I could see that some time was going to be involved, but, as I was now "retired," what the heck! I decided to go for it, and thus started planning a trip I shall remember for many years to come!

Photo A. *George Stephens WB3DAC, Tom Abernethy WA3TAI.*

First stop

My first port of call was Dulles International Airport, Washington DC. I had left Heathrow, London, early on Monday, 25th April, 1996. Nine hours later, I was met in the USA, still dressed for an English April, by Tom WA3TAI. The temperature was around 90 degrees, and I was *very* warm!! Tom drove us back to Accokeek, Maryland, taking in some of the very picturesque countryside on the way.

We spent three days looking around the local area, during which time I had a ride-along with a Washington DC police car. Tom is a policeman and was able to fix this up for me. However, I had to get up at around 4 a.m. in order to have a typical day with him. I must admit that

riding around Washington DC in a high-powered police car was a real thrill, even though the most exciting event was handing out parking tickets! Tom and I visited many places of interest, including the amateur radio station at the Capitol Building, W3USS. Our host while we were there was George Stephens WB3DAC (**Photo A**).

We met up with Willy W1ZX, who runs an 432 MHz EME station and had built a 24-foot dish especially for EME. Willy runs a cool kilowatt to the dish, so the ERP is sufficient to obtain a reasonable reflection from the Moon. He is at present making a larger dish!

Tom, Willie, and I set out for Dayton, driving from Accokeek, Maryland. It was to be roughly a 12-hour trip. Traveling this distance did not seem so bad in Willie's 4x4 truck, and the roads are certainly built for comfortable long-distance motoring. Scenery along the route is superb, taking the Appalachian Highway, mountainous country mile after mile, which is quite different from the flatlands of Norfolk, UK.

Dayton is renowned for either very good or very bad weather. Unfortunately, I did not feel too comfortable with that. However, it really is worth a visit and we had a great time there, meeting with lots of amateurs and looking at all the goodies. I met with a wild bunch of amateurs who all belong to a fun club called the International Order Of Krazies (IOOK).

One colourful character comes from Waco in Texas, Hoss Karami WA5ZAI, a really nice guy. We were invited to a club meeting after Dayton. This was held at the home of Keith and Marian Farley, WA8ZWJ, in Union, Ohio. There must have been about thirty people who descended on this couple, and we had a lot of fun.

Whilst I was at the show, I decided to purchase an update for my computer system, but the company I purchased the gear from took nearly a year to deliver to Tom's address. Even then, one package never did arrive and the company involved was less than helpful. In fact, they never did answer one of my many letters to them. Tom took it upon himself to ship the gear to me, and I am indebted to him for his help. I am hoping that he is going to come to the UK and stay with me so I can repay Tom and Debbie's kindness and hospitality.

One of the many sights new to me at Tom's home location, and which fascinated me, was the feeding of the hummingbirds just outside his window. I had never seen one before and they are really cute little birds! Another impression to stay with me was the number of pickup trucks in the Washington area. Everybody has one, so it seems, and a totally alien habit for an Englishman took me by complete surprise.

Photo B. *Bev and Dick Bendicksen N7ZL inside the Telephone Pioneers Museum, Seattle.*

Tom meets up with several other local amateurs at a local eating place. Not much unusual about that, you might think, but this was at 6:00 a.m.! This is something you will *not* find in the UK, except of course, the truck drivers on the main motorways. Oh, and by the way, I have proved that it *is* true: Doughnuts *are* eaten by the police at 6:00 a.m.!

Second stop

My stay in Accokeek came to a close and I took a plane to Seattle. I have been friends with Dick and Bev Bendicksen for about 35 years now. Dick is N7ZL now, but used to be W7LPM, when we had regular contacts on RTTY. Dick and Bev first visited to present me with a RTTY confirmation in about 1960. We have been corresponding and talking on the air ever since. Dick is now retired from AT&T, as is Bev, and with the exception of a few grey hairs, nothing had much changed with either of us!

They have a very nice place overlooking Puget Sound, and a tremendous view. We went on several trips around the State of Washington, including a visit to the Boeing factory, Mount Rainier National Park, a really lovely place, and then a trip to their holiday home on Marrowstone Island. Dick has a good takeoff here and had an HF station set up, from where we sometimes QSO. Dick was mostly active on the OSCAR 13 satellite in the last ten years or so, and we often talked there, too.

Dick took me to the AT&T Telephone Pioneers Museum, where I was astounded at the amount of equipment that is installed *and* working. He, along with several other retired engineers, is heavily involved in the maintenance of the museum, and spends at least one day per week working there. I took a picture of Dick and Bev inside the museum, **Photo B**.

We spent a very interesting morning there, and Dick jokingly suggested that perhaps we could ship a British Telecom telephone box across for the museum. I made some enquiries about this when I got home, and after lengthy arrangements, telephone calls, and letters to the Prime Minister of the UK, we have now succeeded in this venture. This is a complete story in itself, but a British Red Telephone Box now resides in the museum.

One of my favourite eating places in Seattle is called Country Kitchen. It really is amazing how much cheaper

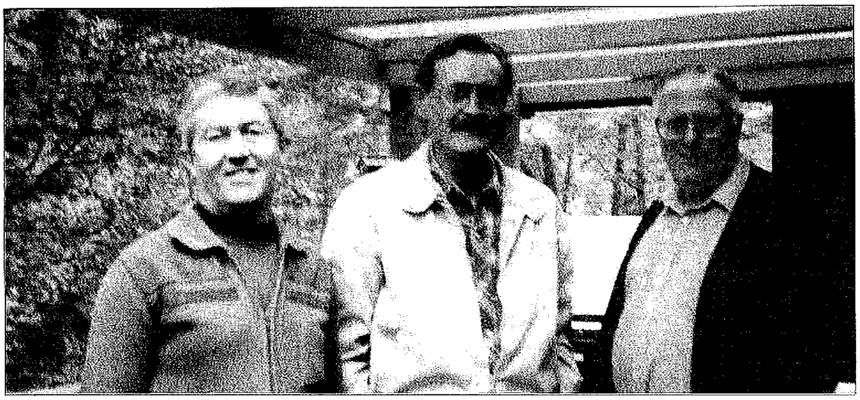


Photo C. *Author Roger Cooke G3LDI, Dave Snape VE7IM, Fred Wyatt VE7PL.*

eating out in the USA is than in the UK. We spent several happy hours in these places.

Third stop

My visit to Seattle ended too soon. I packed my bags, said my goodbyes, and took the ferry to Victoria, in Canada. This was a pleasant journey of about two to three hours, and the scenery is beautiful. Fred and Jean Wyatt met me in Victoria as I came through customs, and we drove to their home just outside Victoria. Fred VE7PL and I have a regular sked each week where we are sometimes joined by Dick N7ZL and Dave VE7IM.

Fred, just like Dick and quite a lot of other amateurs in the USA and Canada, has his station in the basement. This is something the homes in the UK rarely have, but I can see how useful they are! Needless to say, whilst I was here propagation was *not* favouring the UK, and we were not able to keep our tentative skeds with friends back in Norwich.

However, there was so much to do that time really raced by. Fred and Jean took me up to the north end of Vancouver Island to Courtney, where we stayed for a few days with Dave and Suzanne Snape. Dave is VE7IM and retired now, but he has just joined the packet revolution. His very tidy shack is a sight to be seen! We all had a very pleasant stay and a good look around the area. The three "musketeers" can be seen in **Photo C**.

On our return to Victoria, Fred and I dropped in on Larry Joe VE7DIE. Larry is the editor of the Victoria Amateur Radio Packet Association (VARPA) newsletter, a very useful and educational publication. Larry also runs VE7DIE, the local BBS.

At the end of that week, I boarded the hoverjet back to Seattle, spent another couple of days with Dick and Beverly, and then boarded a plane for Los Angeles. I changed planes there and then settled down for the 13-hour flight to Sydney, Australia.

Fourth and final visit

The flight to Sydney seemed interminable. It really is amazing to think that a plane with over 300 people and their luggage can stay up in the air that long! I finally arrived in Sydney, totally disoriented as to time or day, at 5:30 in the morning. I was met by John Bays VK2SB.

I needed several self-pinches to convince myself that I was actually in Australia, a place I'd thought I would never see. We arrived at John's home in Crows Nest, where I had a shower and some breakfast. We decided not to try to cope with any jet lag, but just to go ahead and see how I would survive. John and I therefore went for a tour of Sydney and Darling Harbour and spent the day sightseeing.

I spent the first few days with John preparing the 6-litre Mercedes car that we were to use for our trip up to the north of Queensland. We fitted an HF radio, a Kenwood TS-50, with a vertical on the rear of the car, and a 2m FM radio to use on the repeaters. We also made sure that we had plenty of changes of clothes and spares with us. In case we got stuck in the outback with no AC mains, we also packed a portable generator. As it turned out, we did not have a need to use it.

Having done all of this, John then took me out on his boat up the coast of Australia for a few days, in the company of a friend of his. We sailed as far as Pittwater and Brisbane Water, and visited several of the islands and inlets. Most evenings we were able to talk back to VE7 with superb signals from the boat, and also back to the UK, too, although propagation was not too good. Place names around this area would sound good on a DX QSL card: Coasters Retreat, Dangar Island, Refuge Bay, Acuna Beach—most of them are deserted, but provide superb places to anchor for the night. This we did, enjoying a BBQ on the deck of the boat and some very interesting walks.

Returning to Sydney, I received a telephone call from the UK telling me that my elderly mother had fallen and broken her hip. Luckily, she was in the hospital and had it replaced the same day. This was the second time for her, and at 89, it is very worrying. However, I was told there was no need to return home, but to keep in touch. Amateur radio played a very important role in this during our trip north, as propagation was not good, and relays via stations VK6WL and EA7BA were extremely helpful.

We started from Sydney, driving north along the coast road. John VK2SB drove in the mornings and I took over in the

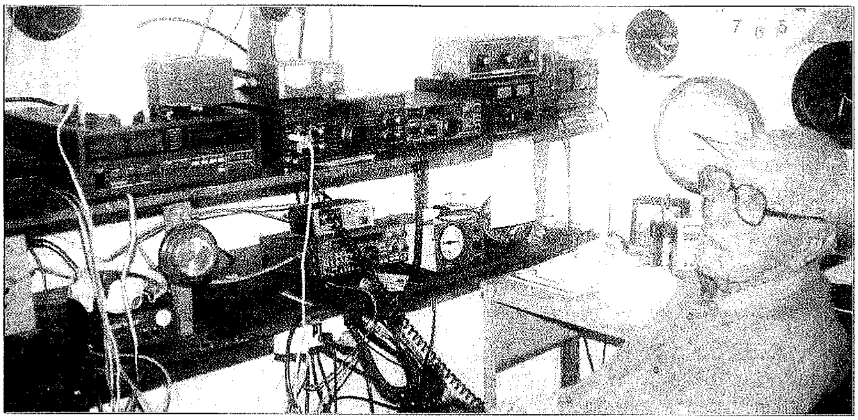


Photo D. *Peter Hill VK2BZA in his shack.*

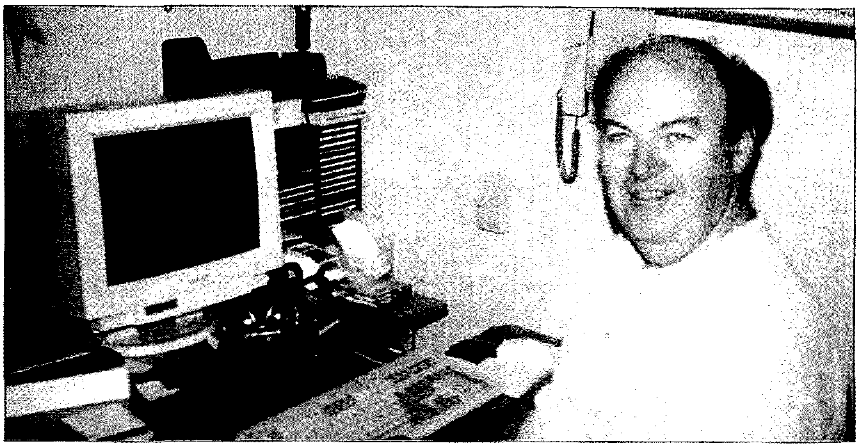


Photo E. Tony Lonsdale VK2DHU, author of Paket.

afternoons. We used the two-meter radio to talk via the Terry Hills repeater as we left Sydney, speaking with Dick VK2GRA, who happened to be in the hospital after suffering a heart attack.

Our first stop was Yarrawonga, overlooking Lake McQuarrie, where we stayed with friends of John. Next day, we drove to Bonny Hills while talking with Richard VK2CHC on the way. We visited Peter VK2BZA. Peter is in his eighties now, but still very active, as you can see from the photograph in **Photo D**. He is very keen on 40 meters and has a two-element beam for that band.

We also visited VK2BZC, known locally as Doctor Paul, as he is a doctor. Paul is very keen on packet and is a member of the local packet group.

That night we also paid a visit to Tony Lonsdale VK2DHU, **Photo E**, and spent a very interesting and pleasant evening with him. Tony is the author of Paket, which is a very popular terminal program. There are about 50 amateurs around the Port McQuarrie area. Twelve are active on packet, with more coming on line. There are forwarding links both on 1200 baud and 9k6 baud, much needed amidst the vast amount of open country, where communications really is a problem. Several links rely on HF as well, distances being such that this is the only reliable method.

Next stop was Coffs Harbour. I speak regularly on HF with John VK2GJK, but by coincidence John was on holiday in the UK at the same time I was in VK-land. However, we did visit his QTH to see where he lived—among the banana plantations! We also visited Bob VK2AWA, 78 years young and also active on HF and packet (**Photo F**).

Driving further north approaching Ballina, we spoke to Gordon VK2AGE, who runs a very active HF Amtor station. We were too far away to call in, unfortunately. We then spent some time in Surfers Paradise, where interests other than amateur radio abound! Driving further north to Beenleigh, we managed to talk to the UK with the help of Alan

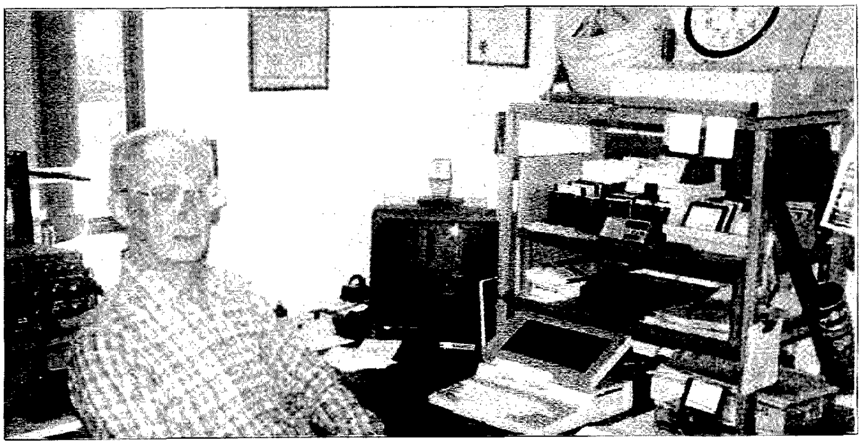


Photo F. Bob Colsell VK2AWA, 78 years young and still active on packet and HF.

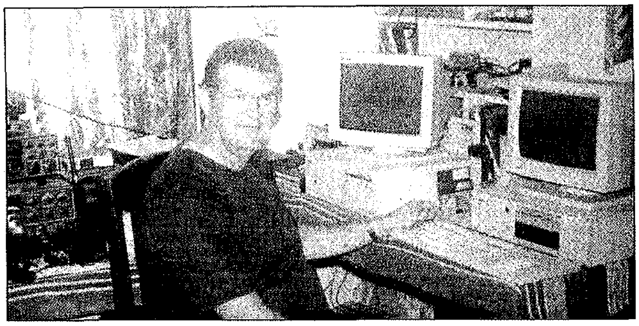


Photo G. Anske Corbett VK4CAB, who runs the BBS in Bundaberg.

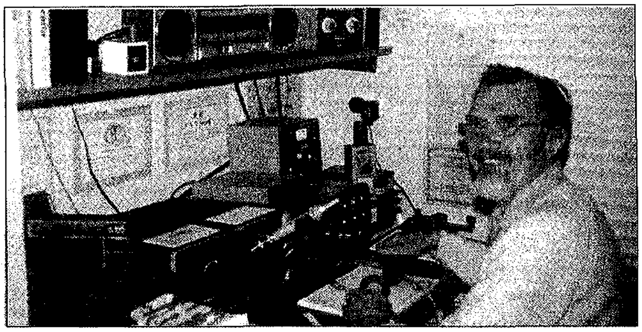


Photo I. Bill Senior VK2WS in Armidale.

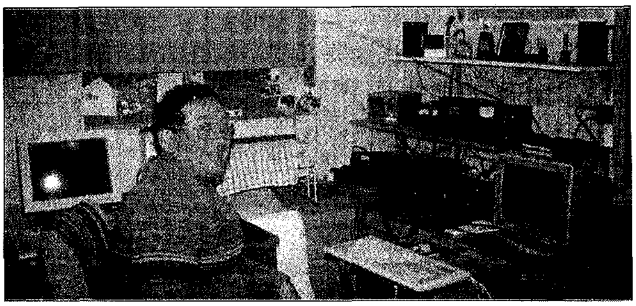


Photo H. Brian Beamish VK4BBS in Brisbane.

EA7BA again, keeping tabs on my mother's progress, which thankfully was good. Propagation did not allow a direct contact, but Alan kindly helped out when he could. Ipswich was next, then to Esk, where I bought an Australian hat, with fly-chasing corks dangling around the wide brim.

Then on to Noosa Heads, Hervey Bay, and Bundaberg. Here we met Anske VK4CAB, in **Photo G**, who runs the local BBS. We then went on to Rockhampton, Marlsborough, and Airlie Beach. After this came Bowen, Inkerman, Cardwell, and finally Cairns.

We drove back via the tableland and rain forest, and after much sightseeing ended up back at Proserpine, near Airlie beach, where we met John's wife Mary at the local airport. We then hired a yacht for a week's sailing in the Whitsunday Islands in the Great Barrier Reef, an experience I shall never forget!

After this, we visited the sapphire mines near Emerald, and did lots of tourist things like visit wildlife parks. At Rockhampton, Mary flew back to Sydney. We continued our journey down the Burnett Highway, through Biloela, Eidsvold, Toowoomba, and finally to Brisbane. Here we visited Brian VK4BBS, who ran the satgate for that part of VK. Brian can be seen in **Photo H**. We spent a very pleasant evening with Brian and his wife Maureen. Brian has now passed on the job of satgate sysop, but is still very active on packet.

After this we had yet another BBQ in the Garradeen National Park, and then spent a very pleasant evening with Bill VK2WS and his wife Margaret, in Armidale, with whom we keep regular HF skeds. Bill has a super location about 3000 feet up in the mountain range where Armidale is located (**Photo I**).

After this, another day or so of driving took us back to Sydney again. We spoke with Jo Harris VK2KAA, who asked us to call and see her. Jo also had David Ramsay VK2KLX with her when we called. Jo is a committee member and David is the president of the Australian Amateur Packet Radio Association (AAPRA). Jo has a superb station, set up such that she can walk around the backs of all her gear. What a sensible idea! She also has complete records—better than just a callbook—of all VK amateurs. AAPRA is similar to VARPA in that they produce a very interesting newsletter well worth subscribing to.

Before I left Australia, I managed to talk John into buying a TNC and antenna, and got him active on packet. I even sent a few messages back home before I left.

In total, I was away for three months, six weeks of which were in Australia. Without the superb friendships forged through amateur radio, this holiday would *not* have been possible; the hospitality I received was absolutely superb, and I am indebted to all my hosts. I only hope I can return the favor some day. It just goes to show what a wonderful hobby we have—one we should cherish very dearly. The memories of this will last forever! 73

Inside MFJ's New 969

The Versa Tuner II could be for you.

Peter A. Bergman NØBLX
3517 Estate Dr. SW
Brainerd MN 56401

I had already decided that I needed a new antenna tuner before I saw the MFJ-969 Deluxe Versa Tuner II. I had been using their 949, which was doing a good job for me, but the guy I had borrowed it from wanted it back. The 969 looked good, so I ordered one.

When the new 969 arrived, it looked great. Then I did something that may seem really strange. I left the new tuner on the kitchen table, poured a cup of coffee and sat down to read the instruction manual.

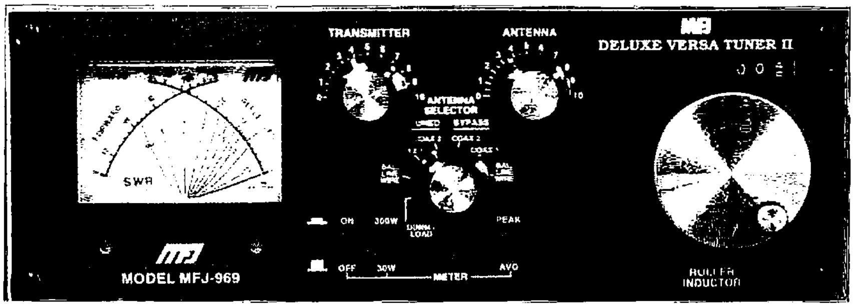


Photo A. The well-made, easy-to-use, MFJ Deluxe Versa Tuner II.

The MFJ-969 is a "T"-match tuner rated at 300 W RF. It covers all bands between 160 m and 6 m. I like to work six sometimes, so having a tuner with that coverage is a real plus.

My first impression of the new Versa Tuner was, "This unit is meant to be used and to last." The finish is a really tough vinyl coating that looks great. The markings on the front panel and meter are clear and easy to read—heck, the rear panel markings are, too. Everything is held together with machine screws and threaded inserts. I like that. The 969 measures only 3.75 inches high by 10.5 inches wide by 10 inches deep (9.5 cm by 27 cm by 25 cm), but has enough heft to keep the coax from pushing it around the operating table.

Another bonus is the air-core roller inductor. The air-core construction is the same type as that used in MFJ's 989C 3 kW tuner. The inductor is firmly mounted and hard-wired to ground and the hot end. The huge contact roller rides inside the coil on a shaft rotated by the large knob on the front panel. The air-core design eliminates a number of the moving contacts present in the rolling inductor arrangement most of us have seen in the past. The turns counter is driven by an "O"-ring-type belt and the reset button is recessed so that it won't be bumped accidentally.

I also like the front panel layout. Frequently I'm able to reach up to make an adjustment without even looking at the tuner (see **Photo A**).

The Antenna Selector switch on the 969 has eight positions. This new arrangement allows the user to adjust the tuner into the internal dummy load or any of the antennas connected at the rear panel. It also allows direct connection to the dummy load or the antennas while bypassing the tuner. Rear panel connectors are provided for the transmitter, as well as for two coax-fed antennas and either a random wire or balanced line fed antenna. An internal balun is included for feeding balanced lines (see **Photo B**).

The SWR/Wattmeter is a dual-movement instrument with three scales. Forward power is read on the left scale, reflected power is read on the right scale, and standing wave ratio is read on the center scale, at the point where the needles cross. This meter has 30 W and 300 W scales and will read either peak or average power. The peak power circuitry can be operated from either an internal 9 V battery or an external source such as the optional MFJ-1312B power pack. The external source will also provide power for meter lighting.

The built-in dummy load is handy and eliminates one more thing on the operating table or to be packed and carried along on Field Day. It will dissipate the full three hundred watts for 30 seconds or 100 watts for a minute and a half. It will handle power levels of 25 watts or less continuously.

I occasionally fire up some of the tube-type gear I've collected. The built-in dummy load and the bypass to dummy load position on the antenna selector really help. The load and tune controls on the rig can be adjusted into the dummy load first. Then, a turn of the antenna selector switch routes the output to any of three antennas, either directly or through the tuner.

Before using the 969 with my rig, I decided to play with it a bit. I connected my MFJ-259 Antenna Analyzer to the tuner in place of the transceiver. To the Coax 1 and Coax 2 ports I connected a G5RV and my battered pre-WARC 40-10

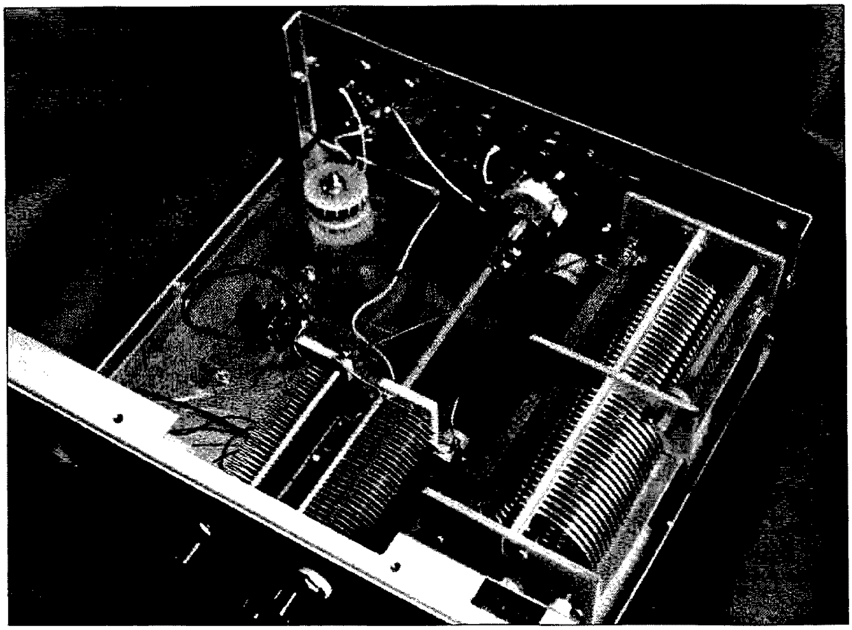


Photo B. Inside view. The new MFJ-969 covers 160–6 m.

trap vertical. It should not surprise anyone that I was able to get a 1:1 match anywhere from 54 MHz to 3.5 MHz on either antenna. WARC, MARS, CAP, you name it. Very easily. The old trap vertical could even be tuned on 160.

Then I decided to get cute and try to duplicate a stunt we pulled during the infamous Zoo Crew DXpedition to Winnipeg. I hooked up a 5/8-wave two-meter mobile antenna to the 969 and was able to get a good match anywhere from 54 MHz to 10 MHz. Below that things started getting flaky, but nine bands on a four-foot whip is pretty darn good. It could come in handy during an emergency.

So, what do you get with the MFJ-969? A lighted SWR/power meter that measures peak or average power from 1.8 to 54 MHz, a 300-watt HF/6-meter dummy load, a heavy-duty 4-to-1 balun, an 8-position antenna switch, and a really versatile HF/6-meter tuner. This unit will not only match dipoles, verticals, inverted vees, random wires, beams, mobile whips, and SWL antennas, but is also handy on the test bench when repairing or adjusting your rig.

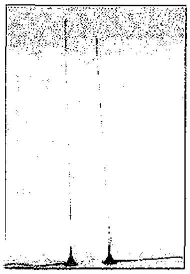
MFJ is well known for their No Matter What™ warranty. Their customer technical support, available as long as you own the product, is also a big plus.

If you're looking for an antenna tuner in the 300 W class, check out the MFJ-969 Deluxe Versa Tuner II. I'm glad I did.

MFJ dealer information or the MFJ catalog is available directly from MFJ at [76206.1763@compuserve.com]; FAX (601) 323-6551; or MFJ Enterprises, Inc., Box 494, Mississippi State MS 39762, (601) 323-5869. Their toll-free order number is (800) 647-1800. Technical support is available at (800) 647-TECH(8324).

NEW PRODUCTS

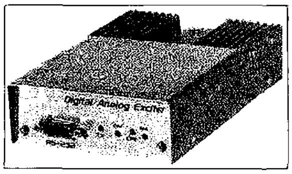
A Ham's Range Should Exceed His Grasp



Your hand-held rubber ducky will radiate poorly in your car—but if you put an MFJ UltraLite™ mag-mount antenna on your car's roof, you can greatly extend the range of your hand-held.

MFJ announces the new MFJ-1721 Two Meter UltraLite, for only $14.95, and the MFJ-1722 Two Meter/440 MHz UltraLite, priced at $18.95. Both include nine feet of coaxial cable and weigh less than two ounces. The flexible whips will fold into any briefcase, bag or glove compartment—these little dandies are meant to go everywhere *you* go!

For your nearest dealer or to order, call (800) 647-1800; FAX (601) 323-6551; or write to: MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.



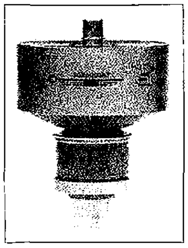
Exciting Pages

RF Neulink announces the new digital paging transmitter/exciter. The DPT series is a high performance, continuous-duty VHF paging transmitter/exciter with both digital and analog modulation capabilities. While normally utilized as an exciter stage to drive high-powered RF amplifiers in wide area paging systems, the DPT series can also be utilized as a stand-alone transmitter for local area, on-site, and in-building paging applications.

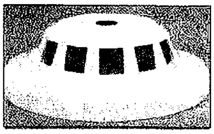
The DPT series is fully synthesized and can be easily programmed in 10 or 12.5 kHz increments via a built-in RS-232 port. Several models are available, covering the 136–174, 218–230, or 260–28 MHz frequency ranges.

For more information contact RF Neulink, 7610 Miramar Rd., San Diego CA 92126. Call (800) 233-1728 or (619) 549-6340; FAX (619) 549-6345; E-mail [rfneulink@aol.com].

No Compromise, No Question

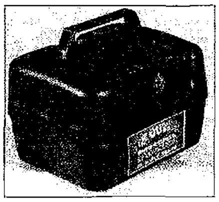


Svetlana Electron Devices, Inc., announces the new 3CX6000A7/YU148 power triode, a drop-in replacement for the one used in popular FM transmitters. This tube is designed with a modern mesh filament which assures a no-compromise, long-life performance. It's manufactured with high-alumina ceramic doped with chromium and molybdenum, which results in a stronger metal/ceramic chemical bond and allows higher processing temperatures than used by western manufacturers. High-temperature bake-out drives gases from internal electrodes during vacuum processing, and clean processing means long operating life. Each Svetlana 3CX6000A7 is full-power RF tested at the factory in Russia, and is backed by the strongest warranty in the industry—12,000 hours/3 years—and the time warranty doesn't begin until the tube is put into operation. Contact Svetlana at their US headquarters, 8200 S. Memorial Pkwy., Huntsville AL 35802; (205) 883-1344; FAX (205) 880-8077; or E-mail them: [sales@svetlana.com] or [engineering@svetlana.com].



Did Somebody Say *Area 51?*

No, it wasn't spotted in the sky over New Mexico. It's the Colorsentry™ SD-865C, another outer-limits-looking goodie, and the latest in the GBC "Smart Value" line. It looks like a smoke detector, but it's an inconspicuous color camera. Install it in any home or office, and it will provide high-quality surveillance with a resolution of 325 lines and a sensitivity of only .4 lux. It comes standard with a 4mm lens and includes mounting hardware and a 12VDC power supply. For more information contact CCTV Corp., 280 Huyler Street, South Hackensack NJ 07606. Phone (201) 489-9595 or (800) 221-2240; FAX (201) 489-0111.



The Name Says It All

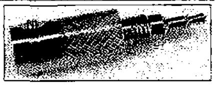
The FAR OUTLET™ is a fully self-contained portable source of 110 volt, 60 Hz household current. The size of a lunch box and light enough to carry in one hand, it provides up to 250 watts continuous and 400 watts peak power. It'll power virtually anything that will run on household current, and with its exclusive "Digiscrub" digital filtering circuitry the FAR OUTLET's extremely low-noise AC power won't introduce discernible distortion into computers and audio devices—its power is as clean as that from a wall outlet. Recharging is as easy as plugging the FAR OUTLET into the nearest wall socket or (with the optional converter) into an automobile's cigarette lighter. Suggested retail price is under $300, so look for it where you get your cool toys.

Crystal Set Projects: 15 Radio Projects You Can Build

The Xtal Set Society proudly announces the publication of their latest book, a collection of radio projects that won a recent building contest run by the Society. Included are step-by-step instructions so you can build and design your own Xtal sets no matter what your background in electronics. The projects are of various designs and difficulty so that everyone can learn something.

Crystal Set Projects is a 6 x 9 paperback, retailing for $14.95 (plus $2.50 s&h). You can find excerpts from it, and other Xtal publications, on the Internet at [www.midnightscience.com], where you'll also find building plans for the famous Quaker Oats™ box radio, vintage magazine articles from the 1920s and 1930s, and a specialty bookstore, Midnight-Science Books.

To order *Crystal Set Projects*, send a check, money order, or your VISA/MC number to The Xtal Set Society, P.O. Box 3026, St. Louis MO 63130. Call them at (314) 725-1172; FAX them at (314) 725-7062; or E-mail them at [xtalset@midnightscience.com].



Midas Touch for Motorola Minis

Nemal Electronics International of North Miami, Florida, has introduced a coaxial adapter for use with Motorola P110 and GP300 hand-held radios. The NE9395 adapter accepts a BNC plug and adapts to the Motorola miniature 3.5 mm-type antenna connector. The adapter features a gold-plated center contact and Teflon™ insulation for optimum performance throughout the VHF and UHF spectrum, and a knurled body for ease of connection. NE9395 is a direct replacement for Motorola part number HLN9756A. For more information, contact Nemal Electronics at (305) 899-0900; FAX (305) 895-8178; E-mail [info@nemal.com].

NEVER SAY DIE

Continued from page 5

E. 87th, NYC 10128, ISBN 0-9643870-0-X, 185pp, 1994.

Next you might want to spring $8 for *Good Teeth - Birth to Death*, by Dr. Gerard Judd, 6615 W. Lupine, Glendale AZ 85304, 117pp, 1997. This will be one of your better reading investments, and you'll sure never drink fluoridated water again, much less poison your body with mercury.

Still another book you'll enjoy is a *Reference Guide - Total Mercury & Other Heavy Metals Detoxification Program*, from National Integrated Health Associates, 5225 Wisconsin Avenue #401, Washington DC 20015. And it's FREE!

Armed with data like this you'll know a lot more about dental amalgam than your dentist.

Making Your Hobby Pay

Yes, you can cash in on your hamming. Well, you can if you are anything but what Scott Adams calls an "induhvidual." If your imagination and motivation limitations have kept you confined to the simplest of rag chewing, with no exploration into our couple dozen satellites, slow-scan TV, the UHFs and microwaves, packet, RTTY, and the many other learning delights our hobby offers, then I guess you're not going to be interested in what you're about to read.

However, if you've shown any signs of creativity at all, you just may be able to cash in on some of the things you've done. You see, studies have shown that on the average your salary the next time you change jobs will be jumped by about $1,000 a year for every article you've had published. That puts the $100-$200 or so pittance we pay for articles to shame, but it's an awfully good reason to put on what's left of your thinking cap (if you can find it) and see what you can come up with.

You might want to write a series explaining some aspect of ham technology, like Pete Stark has been doing for newcomers to electronics and radio. Or maybe you've designed and built a gadget that would get others excited? Or thought up something truly brilliant in an antenna.

Fame and fortune can be yours if you get your word processor going and start shooting us articles. And don't forget the cliché formula to tell 'em what you're going to tell 'em, then tell 'em, and then tell 'em you told 'em. Get us interested right up front with what the benefits are going to be of reading your article. Let's see if you can pry a bunch of fat butts out of their cushy operating chairs and over to the workbench.

Maybe you've had the actual guts to modify a piece of commercial gear? Or to build an accessory?

Or perhaps you've been first in line for a new piece of gear that hasn't been reviewed yet. We'd publish a half dozen reviews every month if you'd get busy and contribute. And none of this listing of specifications—readers want to know how well it works, what benefits it provided you, and so on. If you really like it, see how many readers you can get to buy one. If you don't like it, forget the whole thing. The readers will mainly be buying equipment that's had good reviews and they'll quickly forget the stuff that doesn't get mentioned.

Please take good photos, not instant snap shots. And don't forget a disk copy so we don't have to keyboard everything again.

Now, whatcha got for me?

Gutted

In my senior year in high school I arrived in school one morning with a serious pain in the appendix area. The school nurse poked around, asking if this hurt. You bet! Within a few hours I was in a hospital with my (ugh) hair being shaved by a nurse. My main worry was that I was going to miss the Bob Hope radio show that night. In those days you spent a couple weeks in a hospital bed recovering from surgery. Lordy, what a bore.

It turned out that my dad managed to find a doctor with great big hands, and he'd had a tough job finding the appendix, so my scar was a beaut.

After two weeks in bed my digestive system had just about stopped, generating memorable constipation. Just what I needed to go with the healing incision. And then came learning to walk again.

They've long since learned to operate and get 'em up and out in a day.

Oh, I had one side effect of the operation. The anesthetic they gave me for some reason made it so I couldn't sing for a couple months. And I had been active in the Philharmonic Choir of Brooklyn, so that was also memorable.

Which brings me from 1940 to 1997 and the well-kept medical secret that appendicitis can be treated with a $50 dose of penicillin instead of the $4,500 surgery ... unless the appendix has already burst, which calls for immediate removal. There's a new test for appendicitis (about $200) called FACT, for Focussed Appendicitis Computer Tomography, and it seems to be 100% accurate. It's been revealed that about 97% of appendix surgery can be avoided, and that's around 50,000 operations a year.

Well, I thought you ought to know, and who else would tell you? Certainly not your friendly doctor, who probably is unaware of all this since it hasn't been published in any of the American medical journals. You have to happen to be reading the *British Journal of Clinical Radiology*.

While I'm At It

In case you've been suckered into believing all the baloney about UVs causing deadly skin cancers, I'd like to squelch that exaggeration. Yes, the most common form of skin cancer (carcinoma) is caused by excess UVs, but these appear on the hands and face and are rarely serious. The bad guys are melanomas, which can kill. But they most often appear in areas of the skin not exposed to the sun or on those who seriously overdo

Continued on page 43

73 Review

Secrets of the 1340

Inside Ten-Tec's new QRP transceiver kit.

Mike Bryce WB8VGE
P.O. Box 508
Massillon OH 44648

Ten-Tec can trace its roots back to the time when its first products were mainly kit modules. You could use them to assemble a small, direct conversion QRP transceiver. From these first modules sprang the Power Mite series, the Argonauts, and the rest—as they say—is history.

The 1340 is a single conversion superhet QRP transceiver that will operate on the most popular ham bands: 80, 40, 30 and 20 meters. It's a monobander, so you need to pick the band you want. Sorry, no SSB here—it's a CW-only rig. RF output is rated at 3.5 W into a 50-ohm load.

The controls are basic. You get the usual off/on/volume and station selector with RIT. You'll also notice the lack of an RF gain control. I'll tell you why in a few minutes.

There's ample audio to drive the internal speaker, so you don't need to hug headphones all day long. If you like headphones, no problem—the front-mounted 1/4-inch jack automatically disconnects the internal speaker. The audio is rated at 350 mW into a 4-ohm load.

The whole shebang is housed in an attractive clamshell metal housing. The 1340 has a list price of under a hundred bucks.

Signal flow

A JFET is used as a mixer to convert the incoming 7 MHz signals to an IF of 11 MHz. A double-tuned bandpass filter keeps unwanted signals from entering the mixer.

Once mixed with 4 MHz VFO energy, the result is routed through a four-pole crystal filter having a bandwidth of about 1 kHz. Instead of using a IC IF amplifier chip, Ten-Tec uses an NPN transistor set in common-base configuration.

The IF is now directed to the BFO mixer, an NE612, before going on to the audio preamplifiers and AGC amplifier. The audio power amplifier is an LM386 rated at 350 mW.

The transmitter is a simple and effective circuit. Output of the VFO is mixed to produce 7 MHz. It's filtered to remove any unwanted emissions and then passed on to the driver and the final amplifier. The 2SC2166 will easily produce 3+ watts of RF to the antenna.

The 1340 features full QSK keying with built-in sidetone. The volume of the sidetone is adjustable. The tone is set to match the incoming CW note centered in the four pole filter.

The VFO has a range of about 50 kHz and is tuned electronically by a varactor diode. The main tuning control is a 10k panel-mounted pot. During assembly you can select any 50 kHz portion of the 40m CW band. The RIT is also tuned by a varactor diode and has a range of about 1.5 kHz.

Components

The 1340 comes bundled together with all its parts divided into groups. All the resistors are in one bag, the capacitors in another, and so on. This way, you need not wade through a zillion 0.1 µF caps looking for a lone 5.2k resistor.

All those parts mount on a single Fiberglas™ PC board, about 3.5 by 5 inches, with silk-screen on the component side and solder mask on the bottom. The PC board is single-sided. It's first class, with nice wide traces and fat pads—just right for a new builder should the need arise to remove a part or two. Those micro pads on some PC boards pop off too easily.

Build in steps

Unlike some of the other kits, in which you stuff the board full of parts and then give the whole thing the smoke test, Ten-Tec has you assemble the 1340 a bit differently.

You build the 1340 in sections or, as Ten-Tec says, "phases," trying out each phase of construction before moving on to the next one. There's no need to move on to the next phase of board-stuffing if you can't get the last section to work. I also like this method, as it gives the builder a sense of satisfaction. And it sure lowers the blood pressure because you bypass the

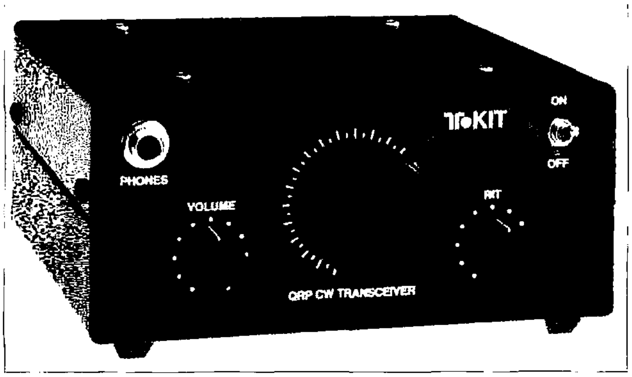


Photo A. The Ten-Tec 1340 QRP transceiver.

smoke test. If you do all the tests before moving on, you're just about guaranteed a working 1340 when you lay the soldering iron down.

The phases of construction begin with the easy circuits and progress into the more complex ones. The T/R switching is the first to go in, followed by the VFO. The VFO, although complex by itself, is needed to confirm operation of the filters and mixers. You continue to add on stages until you are ready to fire up the receiver. With a working receiver, you move on to the transmitter. You button up the case when you're done.

Building the 1340

I enjoy building kits, especially one as well organized as the 1340. The manual is well written, with plenty of information on what makes the section you're working on "work." There's info on troubleshooting the rig and general information on operating QRP. The manual has numerous pull-out sheets with oversized part placement guides. I especially enjoyed the anti-solder bridge overlay showing all the traces of the PC board, but without the pad holes. Every kit should have one of these!

All in all, the manual for the 1340 makes for good reading. The spiral binding allows it to lie flat on the workbench. It's full of assembly tips, such as installing the set screw into the main tuning knob so it won't get lost. Heathkit set the standard for assembly manuals. Perhaps Ten-Tec is about to up the ante with the excellence of this one. I get the feeling Ten-Tec assembled a dozen or more 1340s just for the purpose of fine-tuning the manuals to easy assembly.

Be forewarned: You'd better have on a good pair of running shoes when you start stuffing parts. That's because you'll run all over the PC board looking for the correct PC locations. You run around only in your section, but I did find I spent a lot of time looking at the enlarged overlay and smaller section maps of the board.

If you're an old-time kit builder, and start to jump into the assembly, you'll have trouble. There is no logic (that I could see) in stuffing any of the sections. On one line you're installing R15 and on the next one you're putting in R54 in the opposite corner of the section. So, you experienced builders will need to slow down and read the instructions! All the parts fit the board and there were no surprises.

I have but one complaint about the silk-screen in a place or two. In one section you're asked to install a electrolytic capacitor. Of course, we both know that these guys are to be installed correctly, as they are polarity-sensitive. However, directly above this cap's location was a plus sign on the silk-screen. This not only slowed me down, but brought me to a dead stop. It turned out the plus sign was for the power leads. But I was again slowed down because a black wire goes into the hole with the marking showing a plus sign. Hmm ... This happened to me twice while I assembled the 1340. There are no mistakes in either the manual or the silk-screen. And, as I said before, you need to take your time and read the instructions.

Final assembly

I tested as I went, and smiled all the while—until I got to the first step in the receiver. Although all seemed to be just fine, I could not hear a thing. To make matters worse, most of my test gear was still in storage and unavailable to me. All I had to test the 1340 was my Drake receiver.

I decided to move on to the final receiver sections. After I had installed the audio preamp, AGC, and other related parts, the receiver popped right up. Although I've built countless numbers of receivers, those first signals coming through one you made by hand are always sure to give you a case of the warm fuzzies! That's part of the pleasure of kit building. With a strong signal, I had ear-splitting volume, while the 1340 drew 250 mA at 13.5 V on peaks. Standby current with no signal was under 30 mA.

The transmitter came on-line without a hitch. I tweaked and peaked so my 1340 produced 4.2 W into a 50-ohm load at 13.5 V. At key-down, it required 870 mA of current to produce this amount of RF.

Of course, the 1340 features the famous Ten-Tec full break-in keying. CW is crisp with a nice note. One operator noted the CW had a musical quality to it.

Since the entire 1340 is built on one PC board, it's a simple matter to mount the board inside the supplied case and attach the necessary wires to the connectors. The 1340 uses an honest-to-goodness SO-239 RF connector. You also have the usual power, headphone, and key jacks. I'm not really thrilled about the use of an RCA phono jack for power connections, but that's just my opinion.

Odds and ends and other observations

Just like so many other home-brew QRP transceivers, the 1340 lacks a truly usable frequency display. You know you're someplace on the 40m band, but not exactly where. You have the ability to generate a frequency table by noting the log scale of the 1340. This is not so much a fault with the 1340 as it is typical within this price class of radio.

There's no RF gain control on the 1340. That's because this rig has a real, smooth-working, AGC circuit. It's nothing fancy, but it works just fine. It's really nice to monitor the band and not have to ride herd on the gain control.

I like a receiver that is wide enough to allow you to listen to the band while you're working on another project. The 1 kHz bandwidth is quite refreshing to listen to instead of those super-tight 250 Hz bandwidths some rigs use.

I was rather impressed with the stability of the VFO. Unlike some of the other rigs that use a spoonful of parts and an NE602, the 1340 has a real VFO. The VFO is varactor-tuned using a pot. The RIT is also varactor-tuned. The VFO has its own voltage source and is stable no matter what the supply voltage. The VFO is temperature-compensated, too.

On the other side of the street

I've always had a dislike for tuning a radio with a pot. Perhaps it's just me, but in time, that pot is going to get noisy and fail. The tuning is rather fast, although it's very linear. You can't turn the RIT off, so you must be sure you have the control centered. Sure would have loved to have seen a center-detent RIT control!

There are several coils you must wind for the 1340. Now, before you throw your hands up in the air, let me say it's not hard to do. In fact, if you follow the instructions, take your time, you'll not have bit of trouble. Ten-Tec made it as painless as humanly possible.

While the 1340 has a lot of parts, it's easy to assemble. Is it a kit for first-time builders? Yes, I really think so. If you've never soldered before, get someone to show you how it's done. You may need some handholding in some places, but there's nothing that should get in your way. The 1340 would be a great club project. Call Ten-Tec for details.

NEVER SAY DIE

Continued from page 40

their tanning. The result of the skin cancer panic has been the sale of billions of dollars worth of sun screen.

Your skin and eyes need exposure to the sun on a regular basis; just don't make a religion out of it. Read the books by Ott, Lieberman, and Douglass on the subject. Do your homework.

Snowballs From Heaven

Big as a house! Every day! Well, if you'd read a couple of Sir Fred Hoyle's books, like I asked you to, this science news flash would have been old hat to you. Although the estimated quantity of slush arriving from space is a surprise, astronomers Hoyle and Sandra Wickeramasinge did a very good piece of scientific detective work as reported in their *Diseases From Space* in 1979 and *Evolution From Space* in 1981. Naturally they got the usual ridicule from their compatriots for such absurd ideas.

Hoyle noticed that every now and then a new disease would hit us, and that when it did it would start simultaneously in a number of geographically separated places. And that, after a lot of investigation, led to his writing the first book. It's a fascinating detective story, too bad you haven't read it.

Next Fred and Sandra noticed that the evolutionary development of life seems to have gone on fairly predictable routes, except that every now and then a totally new life form would seemingly appear out of nowhere, with no links to explain it. They also noted that there are a number of species which seem only marginally adapted to the conditions of Earth, and have abilities which have no reason for having developed here. Further, they found that the basic life forms (seeds) could have traveled for millions to billions of years in space and still come to life when they entered a hospitable environment.

With all those tons of slush arriving every day, it seems like it would be worthwhile to send up some big garbage bags to collect some of the stuff so we can see what may be arriving along with all that water.

One more thing, with an estimated 43,000 smaller comets, some with as much as 40 tons of water, reaching Earth every day, how come the space station and astronauts haven't been hit with some giant slushees?

See page 9 of my "Guide To Books" for details about the two Hoyle books.

Moon Rocks

File this under "strange coincidences." A note from Art Bell listener Terrance O'Grady in Minnesota mentioned René's pointing out that the so-called Moon rocks were strangely similar to those found in Antarctica. He says he was part of the IGY III and IV projects (1957-59) and helped bring back to the States five crates of rocks, about 800 pounds worth—the same amount that came from the Moon. What do you want to bet those

Continued on page 47

Special Events

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the December issue, we should receive it by September 30. Provide a clear, concise summary of the essential details about your Special Event.

AUG 24

WOODSTOCK, IL The Tri-County Radio Group, Inc. will hold its Hamfest and Computer Show at the McHenry County Fairgrounds, located just north of Rt. 14 on Rt. 47, beginning at 6:30 a.m. for the flea market and 8:00 a.m. for the exhibitors. Set-up available on Saturday by appt. or 6:30 a.m. Sunday. Talk-in on 146.52 (simplex). For more information or reservations write to: *T.C.R.G., P.O. Box 3107, Skokie IL 60077-6107*; or call *Robert N9KXG, (708) 944-0500.*

AUG 31

DUBUQUE, IA The Great River ARC, Iowa Antique RC and Historical Society, and the Tri-State Computer Users Group will sponsor a Hamfest/Radiofest/Computer Expo August 31st. 8 a.m.–2 p.m., at the Dubuque County Fairgrounds on Old Highway Rd., west of Dubuque. Features include free parking, dealers, flea market, and tailgating; with VE exams at 10 a.m. Adm. is $3 in advance, $5 at the door; 12 and under admitted free. 8' tables are $8. Talk-in on 147.84/.24. Contact *Loren Heber NØYHZ, at (319) 556-5755; Jerry Lange KBØVIK, at (319) 556-3050; or Jerry Ehlers NØNLU, at (319) 583-1016.* Write to *G.R.A.R.C., P.O. Box 546, Dubuque IA 52004-0546.*

SEPT 6

ERIE, PA The Radio Assn. of Erie PA will hold their annual Hamfest and Computer Show on Sat., Sept. 6th, 8 a.m.–2 p.m. This ARRL-sanctioned hamfest will be located at the Franklin Township Firehall near Edinboro and Albion PA. Easy access from I-79 and I-90, 6 mi. south of I-90 Exit 4; or take I-79 to Albion Exit 38, then Route 6N west for 2.5 mi., north on Route 98 for 2.8 mi. Free parking. Handicapped accessible. Adm. $4 in advance, $5 at the door. Children under 12 free. Tailgating $1 per space plus admission ticket. Setup Fri., 6 p.m.–Midnight; Sat., starting at 5:30 a.m. 8' table $8, electric $2 per table. No outside food or beverage sales permitted. Test bench available. VE Exams at 9 a.m., Franklin Center Methodist church, Route 98, 1 mi. north of the hamfest. Talk-in on 146.01/.61. Contact *Chris Robson KB3A, 4485 Kell Rd., Fairview PA 16415. Tel./Fax (814) 474-1211; E-mail [crobson@erie.net].*

SEPT 6–7

AUSTIN, MANITOBA, CANADA The Manitoba Amateur Radio Museum will host its 3rd Annual Ham Fest on the grounds of The Manitoba Agricultural Museum in Austin. For details write to *Manitoba Amateur Radio Museum, Inc., 25 Queens Crescent, Brandon, Manitoba, Canada R7B 1G1.* Remember to enclose an SASE.

LOUISVILLE, KY The Greater Louisville Hamfest/ARRL KY State Convention will be held at the Kentucky Fair & Exposition Center, all indoors. Tickets $6 for both days, Sunday $5 at the door. Send advanced ticket registration with an SASE. Mail requests for tickets and info to *P.O. Box 34444-Q, Louisville KY 40232-4444.* Commercial vendors call *(812) 948-0037, or (812) 282-7007.* For flea market spaces call *(812) 282-4898, or (502) 935-7197.* Check the Web page at *[http://www.thepoint.net/~GLHA/].*

SEPT 7

BUTLER, PA The Butler County ARA will hold its 20th annual Hamfest and Computer Show on the 7th, 8 a.m.–3 p.m., at the Butler Farm Show Grounds, Route 68 west of Butler. Adm. $5, under 12 free. Flea market tailgaters $2 per setup. Indoor vendors $15 per 8' table. Free parking. Talk-in on 147.36(+). Contact *K3LL, 1080 N. Boundary Rd. #C, Cranberry Twp. PA 16066; or call (412) 538-9491. E-mail [K3LL@nauticom.net].*

JOLIET, IL The Bolingbrook ARS will hold its annual Hamfest and Computer Show at the Inwood Recreation Center, 3000 West Jefferson St. (Rt. 52), Joliet IL, one mi. east of I-55. Tickets are $4 in advance, $5 at the gate. Setup times for indoor tables, Sat., 3 p.m.–6 p.m.; Sun. (both indoors and outdoors), 6 a.m. Gates open at 8 a.m. VE exams for all license classes 9 a.m.–noon. Walk-ins welcome. Free parking. For indoor tables, write to *BARS Hamfest Chairman Ed Weinstein WD9AYR, 7511 Walnut Ave., Woodridge IL 60517, or call (630) 759-7005.* For advance tickets, check and SASE to *BARS Hamfest '97, P.O. Box 1009, Bolingbrook IL 60440.* Please allow 10 days for processing. Talk-in on 147.33(+600 kHz); 224.54(-1.6 MHz); 146.82(-600 kHz).

SEPT 11 & 25

FT. WORTH, TX The Lockheed ARC and the Kilocycle Club will co-sponsor VE test sessions for all classes of licenses. They will be held at the Lockheed Recreation Area facility located at 2400 Bryant Irvin Rd., Ft. Worth TX, at 7 p.m. Some testing done by appointment only. For info, call *Ted Richard AB5QU at (817) 293-6745.*

SEPT 12–14

RIVERSIDE, CA The Inland Empire Council of Amateur Radio Organizations will sponsor the 1997 ARRL Southwestern Division Convention Hamcon '97. The event will be held at the Riverside Convention Center in the Mission District, adjacent to the world-famous Mission Inn. Astronaut Ron Sega will speak at the banquet. For more details, contact *Fred Roberts, Exhibits Chairman, 5464 Peacock Lane, Riverside CA 92505. Tel. (909) 687-8145.*

SEPT 13

BALLSTON SPA, NY The Saratoga County R.A.C.E.S. Assn., Inc., will hold its 12th annual Hamfest at the Saratoga County Fairgrounds in Ballston Spa, rain or shine. Gate opens at 7 a.m. Adm. $4 (includes 1 tailgate spot). Free parking. Door prizes, fox hunt, VE test session. You are encouraged to reserve and prepay for tables, $5 ea. Contact *Darlene Lake N2XOG, 84 Wilton Mobile Park, Saratoga Springs NY 12866. Tel. (518) 587-2384. Packet n2xqg@wa2umx; E-mail [lake@capital.net].* Talk-in on 146.40/147.00 and 147.84/.24.

SEPT 14

MONETT, MO The Ozarks ARS will hold its annual Hamfest and Potluck dinner at the City Park in Monett. The park entrance is on Hwy. 37 just south of the intersection of Hwys. 37 and 60. Admission and 8 a.m. tailgating are free. Potluck dinner at noon. Talk-in on 146.97(-) or 145.23(-). For info, call *Joe KBØRVB at (417) 235-8359; or E-mail [nixit@mo-net.com].*

MT. CLEMENS, MI L'Anse Creuse ARC will hold its 25th annual Swap & Shop, 8 a.m.–2 p.m., at L'Anse Creuse H.S. Vender setup at 6 a.m. Indoor tables, $12 ea.; outdoor trunk sales, $5. Admission $4. VE exams at 11 a.m.; contact *Don Olszewski WA8IZV at (810) 294-1567; E-mail [SSTG41a@prodigy.com].* Talk-in on 147.08(+) or 146.52 MHz simplex. For more info, send SASE to *Richard Dzick N8MQU, 31572 Juniper Lane, Warren MI 48093; or call (810) 268-4671.*

SOUTH DARTMOUTH, MA The Southeastern Mass. Amateur Radio Assn., Inc., will hold its annual Fleamarket on the club's grounds at 54 Donald St. in South Dartmouth. The event will run 9 a.m.–1 p.m. Admission is $2 (spouse and children free). Walk-in VE exams at 10 a.m. Space rentals $10. Contact *Bill Miller K1IBR at (508) 996-2969.* Talk-in on 147.00/.60.

TRENTON, NJ The Delaware Valley Radio Assn. will hold their "FallFest '97" at Tall Cedars of Lebanon picnic grove. I-95 to exit 2, S. Broad St. to end, left on Old York Rd., next right onto Sawmill Road. Tailgating, covered spaces, ARRL division official. Admission $5, non-ham spouses and children free. 8' tailgating space $10, includes one admission. Limited 8' covered spaces $15, includes table and one admission. Limited electr. available. Advance reg. available. Talk-in on 146.670(-). For more info, contact *FallFest '97, P.O. Box 7024, West Trenton NJ 08628; (609) 882-2240.*

WHEELING, WV The Triple States Radio Amateur Club will sponsor the Wheeling Hamfest and Computer Show at Wheeling Park, exits 4 or 5 from I-70, 8 a.m.–3 p.m. Admission $3; women, children under 18 free. Talk-in on 146.91(-). Tables under cover, $10; 2 flea markets grass-asphalt, $5 a car. Contact *TSRAC, 2011 St. Hwy. 250, Adena OH 43901. Tel. (614) 546-3930; E-mail [k8an@aol.com].*

SEPT 20

SEBASTOPOL, CA The annual Swapmeet, Auction, and VE testing

session held by the Sonoma County Radio Amateurs, Inc., will take place at the Holy Ghost Hall, 1 mi. north of Sebastopol, off Hwy. 116, at the corner of Hwy. 116 and Mill Station Roads. Setup at 6:30 a.m., general admission at 7:30 a.m. Breakfast and lunch will be available. Sellers' spaces are $10 indoors or out. Tables are provided for indoor spaces only. Contact *Rick Reiner K6ZWB, 2120 Slater St., Santa Rosa CA 95404. Tel. (707) 575-4455;* or write *c/o Sonoma County Radio Amateurs, Inc., P.O. Box 116, Santa Rosa CA 95402.*

WARROAD, MN Lake of the Woods Repeater Assn., Inc., will host a Hamfest at Warroad Area Community Center, 222 Virginia Ave. NE, starting at 1 p.m. Setup at 11 a.m. Banquet and program at 5 p.m. VE exams will be given at 2 p.m., walk-ins OK; bring original and photocopy of current license, 2 IDs (one with photo), check for fee. Talk-in on 147.090/.000. Hamfest and banquet $12, Hamfest only, $5. Banquet limited to 100 plates; reservations suggested. Dealer and flea market tables free with paid admission if reserved in advance. Send check to *David Landby KBØHAP, Rt. 3 Box 10, Warroad MN 56763. Tel. (218) 386-1092.* P/U tickets and table numbers at door. Note to those arriving early: Join us for 9 a.m. breakfast at local restaurant.

SEPT 20 & 21

VIRGINIA BEACH, VA The 22nd Annual Virginia Beach HamFest & Computer Fair, ARRL Roanoke Division Convention, will be held at the Virginia Beach Pavilion Convention Center. Show hours are Sat. 9–5 and Sun. 9–4. Load-in and setup on Fri. after 1 p.m. No smoking allowed in the Pavilion. Booths must be attended throughout the show. No breakdowns until after 3 p.m. Freight forwarding is available, info upon request. No outside tailgate this year. Commercial booth spaces available at $150 per 10' x 10' space, including tables, drapes, curtains, elec., 2 chairs, and 2 admission tickets. Additional tickets required for each additional person working the booth. Tickets are not transferable. For more info, contact *Lewis B. Steingold W4BLO, (757) 486-3800 or (757) 426-3378. Fax: (757) 486-0757.*

SEPT 21

ADRIAN, MI The Adrian ARC will hold their 25th Annual Hamfest and Computer Show at the Lenawee County Fairgrounds in Adrian, 8 a.m.–2 p.m. Tickets $4 advance, $5 at the door. Trunk sales. VE testing, forums. Contact *Brian J. Sarkisian KG8CO, 139 N. Main St., Adrian MI 49221. Tel. (517) 265-1537, or [kg8co@juno.com].* The club Web page is at *[http://www.qsl.net/W8TQE].* Talk-in on 145.370(-).

CAMBRIDGE, MA The MIT Electronics Research Society, the MIT Radio Society, and the Harvard Wireless Club will hold a Tailgate Electronics, Computer and Amateur Radio Flea Market, 9 a.m.–2 p.m., at Albany and Main Street in Cambridge. Admission $4. Free off-street parking. Tailgate room for 600 sellers. Sellers $10 per space at the gate, $9 in advance (includes 1 adm.). Setup at 7 a.m. For space reservations or further info, call (617) 253-3776. Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT BR, Cambridge MA 02139-7082.* Talk-in on 146.52, 449.725/444.725 pl 2A, W1XMR/R.

CINCINNATI, OH The GCARA "Communications Expo '97" will be held at Kolping Center, 10235 Mill Rd., Cincinnati. This show is sponsored by the Greater Cincinnati Amateur Radio Assn., for the amateur radio, computer, and radio-controlled hobbies and industries. Some of the events being featured are: large flea market, computers and software, hidden transmitter hunt, forums, ladies' programs, commercial vendors, national manufacturers, etc. Admission is $6 in advance and $8 at the gate. For more details, contact *Paul N. Riedel WB8NFT, Chairman, 6850 Edmar Ct., Cincinnati OH 45239. Tel. (513) 733-3900 or (513) 681-6263; E-mail [PNR280@msn.com].*

NEW PORT RICHEY, FL The 7th annual Hamfest & Computer Show, hosted by the Suncoast ARC, will be held at the New Port Richey Recreational Center, 6630 Van Buren, New Port Richey. Admission $5, under 12 free. Tables $15 ea., electric $5. For more details contact the *Suncoast ARC, P.O. Box 1992, New Port Richey FL 34656;* or call *Mimmie KO4FB, (813) 937-7455. E-mail Marv N2AT [MARVB@IX.NETCOM.COM].* Talk-in on 145.35(-) and 147.15(+) rptrs.

NEWTOWN, CT The Western CT Hamfest will be held at the Edmond Town Hall, Rt. 6, in Newtown, 9 a.m.–2 p.m. Setup at 7 a.m. Talk-in on 147.12/.72. New equipment dealers, flea market, tailgating, electronics, computers. Tables $10 ea., tailgating $6 (includes 1 admission). Admission $4 (under 12 free). Contact *Bill Schaeffer N1PJG, P.O. Box 3441, Danbury CT 06813-3441. Tel. (203) 798-2831.*

SEPT 27

SCHNECKSVILLE, PA The Delaware-Lehigh ARC will hold their annual Hamfest this year to celebrate their 50th anniversary. Bring the family and a picnic lunch to the Schnecksville PA Fire Company on PA-309, 4 mi. north of US. 22, to help celebrate. Admission $1. Tailgate spaces $2. No reservations. No inside spaces. Grounds open at 5 a.m. for tailgaters. Talk-in on 146.70 rptr.

DAYTONA BEACH, FL The Embry Riddle ARA and the Daytona Beach ARA have joined forces to present a hamfest on the campus of Embry Riddle Aeronautical University at the Daytona Beach International Airport, 9 a.m.–5 p.m. It will include new and used equip. vendors, VE exams, a fox hunt, and forums. Admission is $4 in advance, $5 at the door, with paved and handicapped parking available. Talk-in on 147.150(+). For info contact *John Munsey at (904) 677-8179; E-mail [K4BV@JUNO.COM];* or check out the Web site at *[http://erau.db.erau.edu/~stokess/hamfest.html].*

HORSEHEADS, NY The 22nd Annual Elmira International Hamfest-Computerfest will be held 6 a.m.–3 p.m. at Chemung County Fairgrounds in Horseheads. Free flea market; ham and electronic gear preferred. VE exams on the grounds at 0900; walk-ins accepted. Dealer displays. Free parking. Bunny hunt. No charge for RVs and trailers coming in Sat. a.m. and out Sat. p.m.. Campers in before 9 p.m. Fri., $15 hookup, $10 no hookup (collected by the county). Admission $4 in advance, $5 at the door; 10 and under free. Make checks payable to *Amateur Radio Association of the Southern Tier, Inc. ("ARAST"),* and mail with an SASE to *Elmira Hamfest, c/o Dave Lewis, 465, CR 13, Van Etten NY 14889. Tel. (607) 589-7495.*

SEPT 28

YONKERS, NY The Metro 70cm Network will present another Giant Electronic Flea Market, 9 a.m.–3 p.m., at Lincoln High School, Kneeland Ave., in Yonkers. Free parking. No tailgating. Indoor flea market only. VE exams. Donation $6, kids under 12 free. Table setups at 7 a.m. To register, call *Otto Supliski WB2SLQ, (914) 969-1053.* Vendors: $19 1st table, $15 each additional. All tables 30" x 5', or bring your own tables at $14 for a 6' space. At the door, $25 each table, $20 for a 6' space. Full payment is due with registration. Talk-in on 449.425 MHz pl 156.7; 223.760 MHz pl 67.0; 146.910; and 443.350 MHz pl 156.7.

OCT 3–4

SPRINGDALE, AR The NWAARC "Hamfest '97" will be held at Jones Center for Families, Corner of Hwy. 265 and E. Emma Ave. (north of the airport), Fri., 7 p.m.–9 p.m.; Sat., 8 a.m.–2 p.m. Setup both days. Vendors, traders, refreshments, forums, prizes. VE Exams (pre-reg.). Admission $5. Tables $6. Tailgate $4. Free parking. Talk-in on 146.70/76(-). Contact *Northwest Arkansas ARC, P.O. Box 24, Farmington AR 72730;* or call *Bryan Spain at (501) 789-2690.*

OCT 5

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th Street, Queens NY. Doors open for vendors to set up at 7:30 a.m.; buyers admitted at 9 a.m. Free parking. Donation: buyers $5, children under 12 admitted free; sellers $10 per space. Talk-in on 444.200 WB2ZZO rptr. and 146.52 simplex. For more info, call *Arnie Schiffman WB2YXB at (718) 343-0172, eves. only.*

OCT 12

DURHAM, CT The Nutmeg Hamfest Alliance will host the Connecticut State ARRL convention with forums and seminars conducted by noted experts. The event will be held in conjunction with the 1997 Nutmeg Hamfest at the Fairgrounds in Durham. Early setup on Sat., and overnight camping will be available. A special Hamfest rate will be available at several motels within a 10 minute drive of the fairgrounds. Inside 6' x 8' booth with a 6' minimum table, $15 ea. Inside 6' x 8' booth only (prepay by Sept. 1st), use your own tables, $5. Outside tailgate/campsite, 30' space, $10. Get a $5 discount if prepaid by Sept. 1st. For further info, contact *George Barker K1BIY, 9 Edgewood Rd., Portland CT 06480. Tel. (860) 342-3258.*

SPECIAL EVENT STATIONS

AUG 30–31

BOWLING GREEN, KY Station N4HID will be operated by the Western Kentucky DX Assn, 0100 UTC Aug. 30th–2400 UTC Aug. 31st, in recognition of the contributions made by animals to science, and for their companionship with mankind.

Operation will be on 7330, 14280, 21380 and 28580 MHz. Certificates will be available. Send name and address to QSL to *Ed Gann N4HID, 445 Elrod Rd., Bowling Green KY 42104.*

AUG 31

THOMSON, IL The Palisades ARC and 90 West DX Assn. will operate Station W9BPT, Aug. 31st, 1700Z–2100Z, to celebrate Thomson Melon Days. Operation will be on the lower portion of the General 40- and 20-meter bands. For a certificate, send QSL and 9" x 12" SASE to *Bob Plumley K9IEG, 1123 West Main St., Thomson IL 61285.*

SEPT 6

MATTHEWS, IN The Grant County ARC will celebrate the 27th annual Cumberland Covered Bridge Festival and Antique Engine, Car and Tractor Show. Station W9EBN will operate 1500–2200 at 7.240, 14.260, and 146.460. Send large SASE to *Chuck Newlin W9C5Y, P.O. Box 135, Matthews IN 46957-0135.*

SEPT 8–13

ATLANTIC CITY, NJ The Southern Counties ARA will operate Station K2BR, Sept. 8th to Sept. 13th, from the Miss America Pageant on Absecon Island (IOTA NA111). Phone: 25 kHz inside lower General class band edge; CW: 65 kHz inside lower General class band edge: Novice: 28.100–28.500 kHz. QSL with a #10 SASE via *SCARA, P.O. Box 121, Linwood NJ 08221.*

SEPT 13 & 14

BENTON HARBOR, MI The Blossomland ARA will operate special event station W8MAI, to celebrate the 50th anniversary of "The Heath Company." Operation will be on all HF bands, and depending on conditions, 6 and 2 meters. An all-Heath station will operate primarily on 20 and 40 meters. Please send all QSL requests to N8SHZ at the *Callbook* address and include a #10 SASE.

SEPT 20–21

RICHLAND, MI The Southwest Michigan Amateur Radio Team will operate NC8O to commemorate the 75th Anniversary of The Kalamazoo Symphony Orchestra. The station will operate on or about 3.975, 7.275, 14.275, 28.4375, 51.375 MHz from 1800 UTC Sept. 20–0200 Sept. 21. For a certificate of commemoration, please QSL to *SMART, c/o Dennis Fitzpatrick, 4378 Vauxhill Dr., Paw Paw MI 49079.*

SEPT 27–28

HAMPTON, VA The VASC Amateur Radio Group, Inc., will operate KE4ZXW from the Virginia Air and Space Center in Hampton. The station will be on the air Sat. and Sun. for UHF/VHF 0000Z–2400Z via KO–23 or KO–25, and on HF both days 1500Z–2200Z. Freq.: Listen at :00+ on 7.265 and :30+ on 14.265. This is in celebration of 2 years of uninterrupted 9600 baud automatic satellite station operation, and management of a fine, visitor-friendly Amateur Radio exhibit. An anniversary QSL will be issued to those sending QSL and SASE to *Ed Brummer W4RTZ, 108 Oyster Cove Road, Yorktown VA 23692.*

Number 46 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the December 1997 classified ad section is October 12th, 1997.

NEVER SAY DIE

Continued from page 43

Antarctic rocks aren't missing now?

Baloney!

Actually, I've never liked baloney, either as a food or intellectually. But there sure is a bunch of it around. Wow!

I do enjoy a nice strong salami, even though I know it's lousy fuel for my body. It's the preservatives that'll slowly kill you, just as they do in the other foods which are designed to have a long shelf life.

As a kid my mother never fed me any of the luncheon meats, so my first experience with salami was when I was in the Navy. Every so often a group of us from the Radio Materiel School on Treasure Island in San Francisco Bay were drafted to stand watch at night at the radar lab atop Yerba Buena (Goat Island), the island to which Treasure Island is attached and through which the Bay Bridge passes. Talk about boring on the 12–4 a.m. watch! The break in the boredom came at 2 a.m. when salami on whole wheat sandwiches with an apple were handed out. I've liked salami ever since.

Sorting out the intellectual baloney is more difficult. There's no simple taste test. So I do my best to read the piles of letters from readers who are upset over conspiracies or who are pushing some sort of health food supplement for which they just happen to be a distributor in the usual multi-level marketing approach.

My early family training made a big deal out of being right, with the dictionary coming out frequently to settle word arguments. The result is that I really hate being wrong about things, so I tend to do my homework carefully before reporting on things I think will (or at least should) interest you. So naturally, when I get a letter from a reader saying "I don't always agree with you," my back is up. Oh yeah? On *what* don't you agree? And, sir, have you done your homework or are you just a prisoner of either ignorance or maybe bum dope from school or TV? Most of the time I cite my references and don't ask you to believe what I'm reporting at face value.

If my critics would take the time to read some of the books in my guide they'd be a lot less critical.

But, of course, it's a whole lot easier to just disagree and not bother to read first. And most of us can't help taking the shortcut. When we get sick we want a pill, and don't bother me about how I did it to myself by poisoning my body with sugar, white flour products, mercury and other stuff. Gimme a pill. If it hurts take an aspirin and never mind that the body is sending a message that something is wrong. Don't worry about the cause, just shut off that damned alarm system.

Grumble.

Dim Bulb

In my self-elected role as an iconoclast I've been trashing many of your beliefs—in our schools, colleges, medical industry, money, the federal and state bureaucracies; our war on poverty, drugs, and crime. The fact is, the more I've read and learned, the less respect I have for what we've let happen to our government. The founding fathers had a pretty good thing going here, but through indifference we've let money and power screw it up.

I recognize that mine is a voice in the wilderness, but instead of grumbling about the darkness I'm trying to turn on a small light of reason. There are a bunch of things that have gone wrong, but not one of them that we, as a people, can't fix. And for every complaint I've raised, I've also offered what seems to me like a practical proposal for solving the problem.

Over a hundred years ago Alexis de Tocqueville visited America and said of us, "I do not fear that they will meet with tyrants in their rulers, but rather with guardians." A government led by such men "does not destroy, but it prevents existence; it does not tyrannize, but it compresses, enervates, extinguishes, and stupefies a people, till they are reduced to nothing better than a flock of timid and industrious animals, of which the government is the shepherd." Say baa-a-a.

Crop Circles

Several years ago a farmer from neighboring Francestown called and asked me to come out and see some crop circles he'd found in a field he was mowing. Sure enough, the grass was all stunted in a circle about 20 feet across and a couple feet wide. The farmer said he'd been mowing the same field for years and this was the first time he'd ever seen anything like this.

I talked to the woman who lived next to the field and she told me about a weird experience she'd had a few weeks before when something completely silent hovered over the house, shining down an extremely bright light. It hung there for a few minutes and then moved off quickly toward nearby Crotched Mountain.

When her husband got home she told him about the experience and he ridiculed her for having an overactive imagination. The next day he apologized. He'd been up doing some work at the Crotched Mountain Foundation, where they reported seeing the silent bright light too.

Yes, I know about the farmers in England who've had fun making crop circles, but I also know that most of the circles have no logical explanation, and some are really weird fractal designs, all done in one night, and with no signs of anyone entering or leaving the field.

A chap that Art Bell interviewed recently looked at a photograph of one particular crop circle and something occurred to him. It had a group of concentric circles, each with a round lump in it. He thought this looked like the right size and shape for the orbits of the planets. But there was one really strange thing: there was no orbit with the Earth!

So he put the position of the planets in their orbits into a computer to see at what date they would be in that relative position.

It came out to July 2000. The inference is that in July 2000 the Earth might cease to exist.

How could that happen? Well, if a really large comet were to hit the sun on the side away from the Earth it might send a huge flare out the other side which could turn the Earth (and us) into a cinder. He figured the flare would take about 85 seconds to get here. My what a pileup there'd be at the Pearly Gates with billions of people in line, milling around, with the French, I expect, demanding to be first.

Let's look at the bright side, this scenario gives us two more months over Richard Noons's predictions in his book, *5/5/2000*. But it robs us of 12 years of sitcoms and ball games that the Aztecs predicted would come to an end in 2012. And it's in line with the predictions of several "remote viewers" who have been looking into the future and for some reason have been drawing a complete blank after the year 2000.

Hey, if the Earth gets cinderized, where will we reincarnate to? This could discombobulate both heaven and earth. And think of the housing shortage in Heaven!

Call Me

You're familiar with those nicotine patches the poor wretches addicted to nicotine use to try and kick this vicious and destructive stupid habit, right? You put nicotine on the skin and it goes through. Maybe you've read about DMSO, which does the same thing. You dab some on and a little later your breath smells like garlic.

Therefore it shouldn't take a big jump of intellect to suspect that just maybe some of the other things we daub onto our outer membrane may be making a trip into our bloodstream and thence to areas where we might not want said crapola.

I'm reading the label from a P&G deodorant stick. Ingredients: Aluminum zirconium trichlorohydrexgly in an antiperspirant base of cyclomethicone, stearate alcohol, talc, dimethicone, hydrogenated castor oil, polyethylene, silica, dipropylene glycol, eicosanol or benyl alcohol, and pentadecalatone. Okay, trusting consumer, how many of those wonderful ingredients do you want in your blood stream? Hey, note the first (and largest) ingredient is an aluminum compound. Guess where aluminum goes when it gets into the blood? You got it, the brain. Just what you want there to reduce you to a gibbering almost-memoryless idiot, via Alzheimer's.

I'd sure like to see the results of some tests tracking the ingredients in deodorants with tagged molecules from our armpits to the final migration area of the body. What do our bodies do with stuff like that when it starts seeping in through our skin? This is certainly nothing that the evolution of our bodies expected to have to cope with. The minimum disturbance will, I expect, be an attack on the immune system. The worst, layers of aluminum up where the brain used to be.

There are some non-aluminum deodorants on the market. The ingredient list on Suave Super Stick says: Propylene glycol, water, sodium stearate, fragrance, triclosan, FD&C Blue #1, FD&C Yellow #5. So what the heck is "fragrance"? And what mystery chemicals are in the FD&C #1 and 5 colors? I trust the FD&C about as much as I do Congress and the Administration. What will triclosan do when it seeps through your skin into your bloodstream? Well, heck, all life's a gamble, right? So perhaps we should bet the future quality of our health on Helene Curtis, P&G, and the FD&C and forget it. We know we can trust big corporations not to hurt us, right? Like Liggett & Meyers and R.J. Reynolds.

I'm dabbing on some stuff from Now Foods (Glendale Hts., IL 60139). Ingredients are "zinc oxide, talc, rice starch, calendula extract, arnica extract, vitamin E d-alpha, ascorbyl palmitate, citric acid, grapefruit extract in a base of safflower oil, beeswax, lanolin, and natural fragrance. Contains no aluminum or preservatives." I'm not sure about everything in there, but most of it seems harmless, and it does the job. My mother went the Alzheimer's route, so if I find my memory failing I'll recycle my soul and hope to do better in my next incarnation.

If you are interested in getting the Now Foods stuff and have trouble finding it, I suppose I could become a distributor. But then I'd be accused of a conflict of interest and promoting the goo just to make money. But why should I start worrying now about what others think of me? My grandmother was always worried about "what will the neighbors think?" So I'm going to continue to do what I think will be the best for the most people and give my many critics more to talk about.

What other poisons are you putting on your skin? I'm looking at a can of *OFF*. Ingredients are "N,N-diethylmetatoluamide, related isomers, and inert ingredients." My, isn't *that* informative? So how much of those mystery chemicals do you want absorbed through your skin into your blood stream, for your body to figure out where to store?

The can suggests that all is not well by warning against getting the stuff on your lips, into your eyes, or damaged skin, and so on. Plus they recommend that you wash it off with soap and water as soon as you can after using. Plus wash any clothes that have come into contact with it. Sure sounds benign, doesn't it? Oh yes, "If swallowed: Call a physician or Poison Control Center. Get medical attention. If you suspect that you or your child is reacting to this product, wash treated skin and call your doctor." Hey, guys, what about any possible long-term effects as this poison (which is what it is) seeps into our blood and lymph systems? By then it's too late to wash anything off. Lawyers, please note a viable alternative to the Twinkie defense when trying to get your next murderer off.

That N,N-d-m-t stuff must sure be powerful, as they warn against getting it on watch crystals, synthetics, furniture, plastics, leather, or painted surfaces. Oh, yes: "May cause skin reaction in rare cases." I suspect it causes a skin reaction in all cases, it's just that some are more noticeable than others.

And here we are, as I write, in the middle of both black fly and mosquito seasons.

Tax Dollars At Work

The next time you run short of things to talk about in a rag-chew, which I suspect will be in your next QSO, you might want to bring up how our tax dollars are being spent. Presuming that you've been too busy to read any of the exposé books on the subject in my *Guide*, you might just bring up the $65 million we spent training the new police force in Haiti. And now, from the same account, we're spending millions more on Human Rights Watch/Americas to protect people from said new police force.

For instance, when four Haitian police handcuffed Jean Bernard Charles and shot him to death for no apparent reason, his family complained. This was a mistake. They were warned that if they didn't shut up they'd suffer the same fate. Haitians are being tortured by this new police force, just as they were by the old one.

Our foreign policy seems to go from one temporary expediency to another.

New Hams

In May 1997 the FCC reported that 3013 new hams got licensed. Of those 2870 were Techs. That's over 95%. There were 430 upgrades to General. That's almost 15%. Do I have to project the long term results of this trend?

Hey, I ran into a non-retired chap on 20m the other day. It really surprised me. I suspect the average HF operator age is now in the 60s, so in about ten years, unless we change something, there sure isn't going to be much QRM. By 2012, when the end of the world is predicted, I should have most of 20m all to myself.

Laughing All The Way

Norman Cousins laughed his way out of a serious illness. For some reason laughing is good for what ails you. Some people fill theaters with laughter, while others just sit there and smile. If something funny happens you'll know I'm in the theater. I love to laugh.

One of the comments I get very often in letters from listeners to the Art Bell show is how much they enjoy my laugh. No, for all my bitching, I don't take things very seriously.

One of my favorite TV shows is *The Simpsons*. What a bunch of geniuses they've gotten together to write that show! If you enjoy laughing, check out your local Fox Network station for reruns. Their Boston station runs two episodes every evening. I tape 'em and watch 'em while I'm eating the next day, fast forwarding through the commercials.

I also enjoy *Roseanne*, which is also rerunning on Fox. The last year's shows were disappointing. The episodes that have me laughing the most were the earlier ones when David Raether was an associate producer. The credits whiz by too fast to read, but if you slow down the tape you'll see him listed. I noticed because David worked for me for several years on my music magazine and did some fabulously humorous writing.

Continued on page 63

CRRR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041-0099
[carrjj@aol.com]

RadioScience Observing ... again

Regular readers know that I have a passion for radio science, especially from the point of view of combining amateur radio and the related listening hobbies (SWLing, scanning, etc.). "RadioScience Observing" is a term I coined for a series of articles in *Short-wave Magazine* (G-land, ... er, UK, to non-hams) a couple years back. It is used to denote a wide variety of activities, including solar flare detection using VLF or short-wave radio signals, radio astronomy, propagation studies, listening to natural radio signals from Jupiter, whistler and spheric hunting, and other related things. Many of these activities can be done with simple radio receivers, while others require rather sophisticated receiver/antenna systems. In some cases, a ham radio license helps, especially when observing propagation anomalies on the air.

During my surfing on the Internet I've found some interesting sites. One of the most interesting from the point of view of information is a publisher who specializes in this subject: Radio-Sky Publishing (P.O. Box 3552, Louisville KY 40201-3552; E-mail [radiosky@radiosky.win.net]; Web site[http://www.win.net/~radiosky]).

The Radio Astronomy Teacher's Notebook, edited by Jim Sky, is a remarkable source of information. Although the book lives up to its name, the material in it is of interest to a far wider audience than teachers. It contains a large number of practical radio astronomy projects that can be built by most readers of this column. It also contains a lot of information of general interest to people who delve into radio astronomy.

The Radio Astronomy Teacher's Notebook is divided into three sections.

Section One: "Simple Observing Programs" deals with solar observations, solar flare detection by short-wave, magnetometer studies, meteor reflection and related topics.

Section Two: Deals with technical issues such as noise, receivers and the mechanism of natural radio signal generation.

Section Three: is about assembling a radio telescope. It contains a lot of information on recording signals, antennas, low-noise amplifiers, and other components of the receiver. If you have any interest at all in radio astronomy, or any other aspect of RadioScience Observing, then this books belongs on your "must get" list.

Another book I received from Radio-Sky is Radio Astronomy Projects by William Lonc, of St. Mary's University in Halifax, Nova Scotia. Bill, who is known as VE1SMU to the ham community, is a physics professor at St. Mary's and a Jesuit priest. The book contains not only a number of construction projects, but also a wealth of information on radio astronomy. He covers a lot of subjects that normally only mathematicians could love in a manner that makes it accessible to most readers. He also does a good job of explaining interferometry and other radio astronomy techniques.

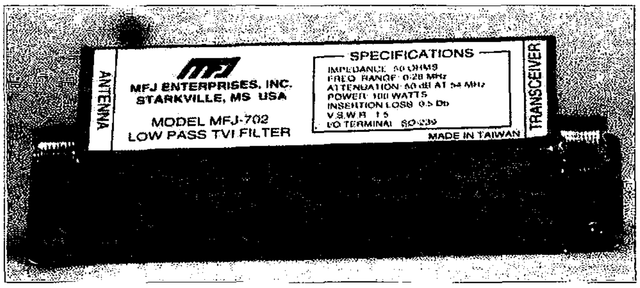


Photo A. The MFJ-702.

Sable Island	Eastern Passage	Wynacht Point	St. Mary's University
144.277 MHz	50.001 MHz	222.051 MHz	2304.40 MHz
220.055 MHz	144.29 MHz	432.398 MHz	
222.055 MHz	220.058 MHz	902.358 MHz	
432.40 MHz	222.059 MHz	1296.385 MHz	
902.345 MHz	432.350 MHz		
1296.344 MHz	902.302 MHz		
	1296.302 MHz		
	1296.398 MHz		

The Sable Island beacons are aimed due west towards Halifax, Nova Scotia. The other beacons are all in Nova Scotia.

***Table. 1.** Beacon frequencies.*

Bill also operates a number of beacons on Sable Island. This island is about 170 miles or so off the coast of Canada, in the Atlantic Ocean. It is well known as both a port of haven for the fishing fleet, as well as a graveyard of ships. Sable Island sits in the middle of one of the Earth's more vicious storm areas. If you want to read a good true thriller on the area, read *The Perfect Storm* by Sebastian Junger. It details a storm that produced huge monster waves, sank some ships and damaged President Bush's Maine vacation home.

One of the stories in *The Perfect Storm* was about a Coast Guard swimmer/jumper who jumped out of a perfectly good helicopter into 60-foot seas to rescue three people on a sailboat. He then jumped into the sea again when it was discovered that the Coast Guardsmen from a nearby cutter were also in trouble during the same rescue attempt. Keep in mind that he does these heroic things for *enlisted* military pay (where do we find such heroic men?).

But enough digression. I exchanged E-mail with Bill Lonc [lonc@husky1.stmarys.ca]. He told me that he would be delighted to receive QSLs, E-mails and other reception reports of his beacons. This is a good chance to do a few VHF/UHF and microwave propagation studies of your own, and would help the scientific efforts of Bill and his students. The beacon frequencies are shown in **Table 1**.

Bill Lonc's web page can be seen on the St. Mary's University website. The URL is [http://apwww.stmarys.ca/~lonc/lonc.html].

The 2304.40 MHz beacon operates using narrow-band FM, but all the others use keyed CW for their ID. Also, the transmitters are all low power [0.5 to 10 watts, except 50.001 MHz (25 watts) and 144.290 MHz (100 watts)].

Product news ...

Received a notice from MFJ Enterprises, Inc. (P.O. Box 494, Mississippi State MS 39762), about a new low-power low-pass filter, their model MFJ-702 (**Photo A**). Hams use these filters between the transmitter and antenna to reduce harmonics that can cause television interference (TVI). The MFJ-702 is rated at 200 watts, and operates over the range 1.5 to 30 MHz, so it takes in all of the HF amateur bands (not to mention CB). It boasts a 0.5 dB insertion loss (which is low), and offers attenuation of 50 dB at 54 MHz. It will, therefore, protect TV channel 2 and up. The MFJ-702 comes with SO-239 standard coaxial connectors, and is sized at 6 x 1 x 1.5 inches. For additional information, write to Richard Critz Stubbs, Jr. KC5NSZ, at the MFJ address given above.

Ask Kaboom

Number 51 on your Feedback card

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

A colorful world

For several months now, we've been exploring the history of video technology, from the first conceptualizing of television to the modern home VCR. Last time, we saw how the basic problem of tape consumption was finally solved.

I mentioned that the azimuth recording scheme worked fine in black and white, but not in color. Ah yes, color—the bugaboo that delayed the VCR for years. Let's see how they finally got it all to work.

Divide and conquer

If deliberately misaligning the video head azimuth kept the signals from the *A* and *B* heads separate, why wouldn't it work in color? Before we get to that, we have to take a look at how color was, and is, recorded in the first place.

It seems logical that you could simply record the entire video signal, including its color subcarrier, and be done with it. Indeed, you can do that. Unfortunately, when you play it back, you won't get usable color on the screen! Why not?

Remember, way back when, that I mentioned the color signal's being very touchy with regard to timing? Even a few nanoseconds of jitter (wobbling in time) will ruin the color. That's a natural side-effect of the basic color encoding scheme, which makes the color value dependent on the subcarrier's changes in phase. "Phase changes," of course, is just another way of saying "a change in timing." Timing errors are indistinguishable from desired phase changes. And that's why timing errors are unacceptable in color TV signals.

When transmitting the signal over the air, timing isn't an issue, because it doesn't change. Well, that's not entirely true: if you've ever had the misfortune to live in an area plagued by TV ghosting, such as Boston, you've seen what it does to color signals. Assuming a good, ghost-free path, though, color travels well.

It does *not* record well. No mechanical system can possibly maintain nanosecond-level timing, not even the ultra-precise quadruplex broadcasting machines which cost more than most people's homes. Tape wobble, bearing play in the head drum, and even thermal expansion and contraction of the tape and drum all introduce errors several orders of magnitude greater than what's needed for good, accurate color. So, how was that problem finally solved?

Bump it down

The key to making color work in the low-cost, helical video recorder was to strip the subcarrier off from the rest of the signal and process it separately, recombining it only near the end of the playback chain of circuits.

Certainly, it was possible to record the entire signal, including color, and then strip the color off and fix its timing problems on playback. That was called "direct color recording," and such machines were built. The drawback was that, due to the color signal's rather high frequency of about 3.58 MHz, lots of bandwidth was required on tape. Remember, video is recorded using FM, so it takes *way* more MHz to put it down on tape than are contained in the actual signal being recorded. The result was very fast head-to-tape speed, wide, expensive tape and big machines, none of which suited the home market. Also, the signal-to-noise ratio was a big problem at such high frequencies, making the color grainy unless very high-quality circuitry was used. While being successful in high-end industrial and broadcast recorders, direct color recording was clearly not the answer for a consumer machine. Besides, even with direct recording of the color signal, some kind of timing correction would have to be applied on playback before usable color could be obtained.

A trick

Color television depends in large part on a trick: the human eye doesn't see fine differences of color when objects are close together. In effect, we see a kind of pastel, with sharp brightness variations and soft color variations. In fact, that's why the whole color subcarrier scheme worked in the first place—because it didn't require tremendous amounts of bandwidth in the signal. In other words, the color elements of the picture never had to be very sharp, as long as the luminance (or black-and-white) part of the signal was.

That meant the color signal didn't really have to be at such a high frequency to begin with! While it was convenient to use a high frequency for getting the signal to coexist, relatively interference-free, with the luminance signal, a lower frequency would still have enough bandwidth for good color. Enter the mixer.

Just like your radio

As you know from your radio pursuits, it's not hard to mix a signal with another one and get the sum and/or difference frequencies between them at the output of the mixer. That's exactly what was done in the color video recorder. First, the color signal was stripped off the rest of the signal, using a filter. Then, it was mixed with a crystal oscillator to make a lower-frequency signal. The resulting signal still had its phase and amplitude changes modulated on it, just as a radio signal does when your rig mixes it with the VFO to get to the IF frequency.

The new, relatively low-frequency signal (around 600-700 kHz in modern home VCRs) was then combined with the FM carrier that handled the luminance signal and applied to the video heads. They didn't interfere with each other, because the FM carrier's lowest frequency was set well above the sidebands of the new color signal.

Seems pretty simple, huh? Could that be all that was required to make a color VCR? Hardly! While it got the signal on tape without increasing the required bandwidth, in no way did it provide a way to get the color *off* the tape and onto the TV screen! Those nasty timing problems, caused by the inescapable mechanical issues I mentioned before, still remained. Solving them is where things got clever and tricky.

Good ol' PLL

Being a ham, you're probably at least somewhat acquainted with the operation of a PLL, or phase-locked loop. Basically, a PLL is a circuit that makes one oscillator track another one's phase. It seems like a useless idea at first, but it turns out to be one of the cleverest and most useful circuits around, finding its way into all kinds of things, from computer hard drives to the frequency-controlling circuits on your rigs.

The PLL has been known since the vacuum tube days. At that early stage of technology, though, it wasn't very practical, because it took lots of circuitry, which meant lots of hot, power-hungry tubes and tons of room. The PLL languished until the solid-state revolution. Even then, it took a board full of transistors, resistors and capacitors to make a useful one—so its use was limited to expensive military and industrial gear.

Nonetheless, use of the PLL had begun to come into its own by the 1970s, at just about the same time the EIAJ standard for half-inch videotape was created. As it turned out, the PLL was the answer to the recovery of color signals from videotape!

Well, this discussion of color processing is gonna be a doozy, and I'm nearly out of room for this month, so I'll leave it until next time. Until then, 73 de KB1UM.

Number 52 on your Feedback card

QRP

Low Power Operation

Michael Bryce WB8VGE
P.O. Box 508
Massillon OH 44648

Perhaps the simplest antenna to erect is the random length wire antenna. All you need are two supports and some wire. Throw in an antenna tuner and you're ready to make contacts.

Random length and longwire antennas

Sometimes we get these two guys confused. I have caught myself referring to a longwire as a random length. What's the difference between the two?

A random length antenna is just what the name implies. Its length is random. Supported between two trees, towers or even houses, the length is dependent upon the supports. If you have a tree 80 feet from your tower and you run a wire from the tower to the tree, your random length antenna is 80 feet long. It's that simple. The random length antenna is fed with a single wire. This feedline also becomes part of the antenna's length.

The longwire antenna, on the other hand, is as long as the lowest frequency wavelength. A 160-meter longwire would be very, very long! Some people also consider a longwire to be shorter than the full wavelength as long as it is at least one half wavelength long for a given frequency. A longwire can only be called "longwire" if it is long in terms of wavelength.

The random wire

Because we have little control on the placement of our supports, we must go with whatever length wire we end up with. Since we don't know at what point along the wire there will be a current or voltage point, it's hard to load a random length wire. Depending on frequency, and the length of the random wire, the feedpoint may have a very high impedance. On the other hand, change the frequency and our feedpoint may have a very low impedance. To counter these oddball input impedances, we need an antenna tuner. Now, before the hate-mail starts pouring in, some of the older tube-type transmitters had a pi-network in the RF output stage that could load a random length wire antenna, provided the antenna was long enough and the feedpoint impedance was close to 50 ohms. Today's solid state rigs lack this pi-network.

Again, since we don't know if we will be feeding a voltage or current point along the wire, random wire antennas have a history of allowing RF in the shack. Running 100 watts with a random wire can sometimes cause the microphone to be hot with RF. The RF floating around the shack can cause all kinds of trouble ranging from RF burns on the lips to sticking electronic keyers. To combat the RF in the shack trouble we need two things.

First, we need a real honest-to-goodness earth ground. Second, we need that antenna tuner I talked about.

A tuner for a random length wire antenna is quite easy to make. All you need is a tapped inductor and a variable capacitor. The schematic for the tuner I made is shown in **Fig. 1**. It's a classic that's been around for decades.

The antenna tuner

Because we're dealing with a random length wire, we have no idea what the feedpoint impedance will be—so we need a tuner that will allow our low Z transmitter output (50 ohms) into an unknown Z.

The tuner I use is very basic. In this configuration, only two components are used. A variable capacitor and a tapped inductor is all you need! Change the wiring a bit and by adding an additional capacitor to the antenna side of the inductor, we end up with a classic pi-network.

In the version I used, the variable capacitor must be isolated from ground. This means you must keep the capacitor's shaft above ground. You'll need some kind of insulated shaft coupling. I've used small hunks of wood in the past with reasonable success. Short pieces of hard rubber tubing slipped over the capacitor's shaft work, too. You'll need a panel bushing and a 1/4-inch shaft extension. I've used old pots for both. The pot is dissected and the bushing removed. The end of the shaft is ground off (to get rid of the pot's wiper) and the coupling attached. The only problem is that the newer pots don't use the standard 1/4-inch bushing anymore. However, I think you still should be able to come up with a working solution. No matter how you do it, the variable capacitor must be insulated from ground.

Getting the parts

Since this is the '90s, such parts as variable capacitors and tapped inductors are not easy to come by. You'll need to go through your catalog pile and start looking. The variable capacitor I used has three sections of about 125 pF. I ganged all three together for a total of about 375 pF. That's about perfect for all bands except for 160 meters. If your random wire is "long" enough, you might be able to squeeze 160 meters with 375 pF.

A good source of a 200 to 400 pF variable capacitor would be the broadcast variable used in the old AM radios. In fact, the one that I used came from a AM radio. I purchased mine from Hosfelt Electronics for a few bucks. Check All Electronics, Surplus Sales of Nebraska and Fair Radio sales of Lima, Ohio.

If you plan on running just one band with your antenna, you may be able to use an assortment of fixed capacitors and switch them in and out of the circuit.

At QRP RF levels, you can get away with the one-inch-square variable poly caps from transistor radios. Attaching knobs to these guys can be an interesting engineering project! Remember, you must keep the capacitor isolated from ground.

The inductor is a bit easier to come up with. Perhaps the easiest inductor would be a hunk of Aircore or B&W coil stock. Hardly Radio Shack™ stuff, but Surplus Sales of Nebraska may have some. How much do you need? Rule of thumb: You will require more inductance for the lower bands.

I made my own inductor out of a length of #14-gauge solid wire. I first took the wire and wound it around a broom handle. Then I laid out some holes in a hunk of perfboard. The holes were spaced an equal distance on 1/4-inch

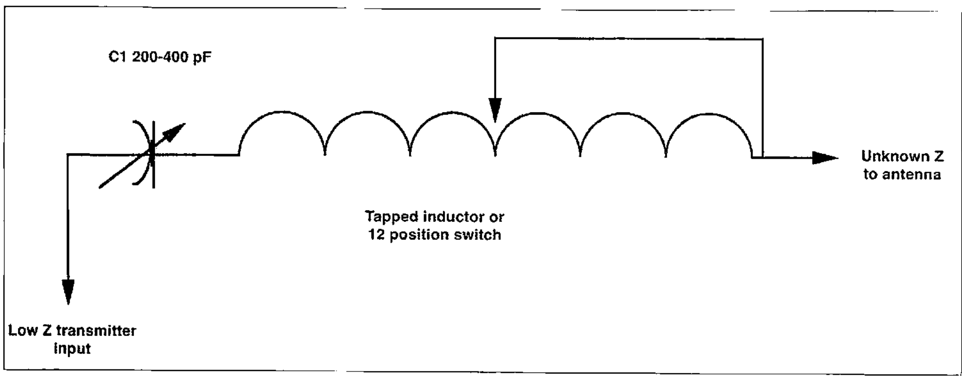


Fig. 1. Schematic for the tuner.

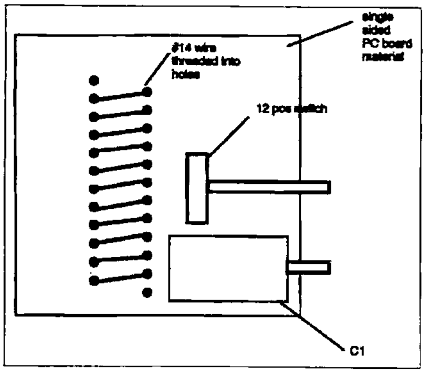


Fig. 2. The inductor.

centers. A second run of holes was spaced one inch from the first holes, but these were offset by one hole (**Fig. 2**).

In effect, I made a screw pattern that allowed me to screw the preformed wire into the perfboard. To make the taps, I soldered wires to every other link at the board. From the board these taps were connected to a 12-position switch. The switch is located close to the inductor. A shaft extension and panel bushing makes the switch assembly very sturdy. Radio Shack handles a 12-position switch that will work at QRP power levels. Just don't switch selections while the power is flowing.

You can wind your inductor around a T-200 core, too. The core size is large enough to handle the wire size required. The larger core size makes winding the wire easier, too. Mount the core on the back side of the rotary switch, keeping stray inductance in check.

If you want to get real serious, order the tapped inductor from Ten-Tec™ that they use in their smaller antenna tuners. It's not cheap, but it provides a zillion taps in a small area. Ten-Tec also carries the shaft couplings and panel bushing. Give them a call for prices.

If you don't want to use a switch to select the inductor taps, that's fine. A clip lead may be used to find the tap you need. It's a trick that's as old as radio itself.

Building the tuner

Antenna tuners should be placed inside a metal box. If you must use plastic, then use copper PC board material to line the inside of the box. A good earth ground is a must for proper operation.

Using the tuner

You will need an SWR indicator of some sort. Basically, you adjust the tuner to minimum SWR. If you can't achieve a low SWR, then move the inductor tap and try again. It's best to go after the least amount of inductance and maximum capacitance. There may be more than one setting that will produce an acceptable SWR. Try and find the one that uses more C if you can. You will get better efficiency if you do.

The Rainbow antenna tuner

While we're on the subject of antenna tuners, at the Dayton HamVention the New Jersey QRP club introduced their Rainbow tuner. Designed by Joe Everhard N2CX, the Rainbow antenna tuner is designed specifically for the 30 and 40 meter bands. You need an endfed half-wave antenna for the Rainbow to work.

The Rainbow tuner has a rather slick interface that uses several colored LEDs, hence the name Rainbow. The LEDs give the user an indication of the SWR on the antenna. An LM339 voltage comparator samples the voltage produced by an absorptive resistive bridge. The resulting voltage is compared against a reference. A high SWR produces a higher voltage which in turn lights the correct LED.

The Rainbow is a slick tuner that will fit inside most of the current breed of QRP transceivers. You can buy your own Rainbow tuner from the New Jersey QRP Club for $25. To order write: George Heron N2APB, 45 Fieldstone Trail, Sparta NJ 07871. Make checks out to George Heron, *not* to the New Jersey QRP Club. You can also contact George via E-mail at: [g.heron@dialogic.com]. Armed with a home-brew tuner and a random wire antenna, the QRP operator has one of the fastest portable setups in the world. Of course, you'll need at least two supports for the wire, but you won't need to carry along coax or connectors. ■

Number 54 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
[dmiller14@juno.com]

With this column (#24), Ham to Ham concludes its second year in the pages of *73 Amateur Radio Today* magazine. Thanks to all of you who've been supportive over the last two years by sending in your many tips, ideas, suggestions, and shortcuts for the rest of us. With an average of four or five tips per month, that's well over a hundred ideas that we've been able to relay so far ... not bad! I always welcome more of your input, however, so don't feel that your own ideas aren't worth submitting ... they are! The basics are pretty simple: What do you feel would be of interest to your fellow hams and electronics hobbyists? That's what I'm hoping to see from you. Anything having to do with ham radio and electronics is appropriate (not all readers are licensed hams ... yet!). Since ham radio encompasses just about the entirety of electronics, it's conceivable that just about any tip in this field of general electronics will likely have some application in our ham or SWL shacks. So fire up your word processor and send me some of your favorite shortcuts. You can send them by Uncle Sam's slow-mail, by cyber-mail, or via the Ham to Ham home page feedback button on the Web at [http://www.rrsta.com/hth]. Take some time to browse the neat page that Mark Bohnhoff WB9UOM has come up with for us. Now, onward to this month's offerings:

Nailing it down!

From Frank Brumbaugh W4LJD: "If you haven't tried it, Liquid Nails™ is a good general-purpose adhesive for holding down trimpots, small relays, electrolytic capacitors, and any number of small parts on a printed circuit board or metal chassis. As hams and electronics experimenters, we often find ourselves adding parts to an otherwise completed item of equipment. Consequently, we don't usually have the luxury of solder pads and pre-planned holes right on the PC board itself for mounting these additional necessities. Super Glue™ is one answer, but it's expensive and a standard tube holds very little. Liquid Nails (manufactured by Macco Adhesives, The Glidden Company, Cleveland OH 44115) is less costly, and a 4-ounce tube will last quite a long time. It's sold to the construction trade as a drywall and paneling adhesive in larger caulking-gun size tubes, but the 4-ounce consumer-sized squeeze tube is great for occasional use by the home hobbyist. It will work with ceramics, metals (including aluminum), rubber, wood, plastic, and so forth. It has a very thick consistency (unlike Super Glue), so it won't run and get into areas where it might be unwelcome! It's very sticky stuff and will begin to set up quickly upon exposure to the air, so you'll need to have the parts that you want to 'nail' down ready before opening up the tube. It takes a day or so for full curing, but the parts will hold pretty well in place considerably sooner than that. Cleanup can be done with mineral spirits and, of course, as with any petroleum distillate product, adequate ventilation is a must. By the way, it comes with a 50-year guarantee ... think the equipment you're working on will last that long?"

Moderator's note: Frank's right. Liquid Nails is a nice product to have around the ham workbench. At Frank's suggestion, I tested it for RF transparency in a microwave oven and it passed. When completely set up (cured), it doesn't seem to absorb any appreciable microwave energy, so it should be reasonably safe to use around RF circuitry. In case you're not familiar with the "microwave oven test," putting a sample of insulating material into your home microwave oven, along with a small cup of water, is a good way to test for RF absorption. If the sample doesn't get warm when the oven is run for a minute of so, then it's pretty safe to assume that it's transparent to radio frequencies (which all insulating materials used in the RF area of ham gear should be). The only other caveat that you have to watch for is moisture absorption (the adhesive becoming hydroscopic). Some adhesives will absorb moisture from the air, with time and age, and can become semi-conductive. Obviously this can cause all manner of strange problems when the adhesive is laid across two or more copper printed circuit board traces. Even a hundred kilohms or so of resistance can upset high impedance circuits quite a bit, and lower resistance can even do some irreparable damage. Keep an eye on that with any new product that you might try.

Two ears are better than one

From Thomas Hart AD1B: "Last year I discovered the fun of hamming through the RS-12 satellite and have been busily chasing DX using it ever since. My usual mode of operation has involved running my Kenwood TS-430S in the dual-VFO mode, and transmitting on 15 meters while receiving on 10 meters. This is what's called mode K operation. It's necessary to estimate the Doppler shift offset by the hit-or-miss method, because the 10 meter receive frequency on the transceiver is silenced during transmit, but this is a reasonably uncomplicated way to utilize RS-12. I've been able to confirm 38 states and 16 countries in just 7 months of working with the satellite in my spare time. A true ham never being satisfied, I recently added the luxury of being able to listen to my return signal on two meters with the addition of another receiver (see last month's 'Ham to Ham' column). This necessitated yet another innovation as described below.

"To listen to my two radios at the same time via headphones, I bought a Sony™ stereo headset at a discount store for just $6 and completely reworked their wiring. I removed the original cable and replaced it with two separate lengths of lightweight 2-conductor speaker wire from Radio Shack™. Each of the new 2-conductor wires then terminates in a connector (also from Radio Shack) appropriate for the headphone jacks of the two radios that I'm using as downlink receivers ... so I've ended up with two meters in my right ear, and 10 meters in my left ear! It's interesting. At times, one frequency may be more audible than the other (due to propagation, background noise, antenna pattern differences, etc.). At other times, reception in both ears is quite good and I have excellent 'stereo' perception using this arrangement. It was a little spooky at first to hear my uplink (sidetone monitor) in my left ear and my satellite downlink CW in my right ear, but now it seems perfectly normal and I'd miss it if I were to go back to the old way! It's an inexpensive way to give this method a try."

*Moderator's note: If you'd rather not completely rewire the headset as Tom did, you could achieve similar results by "splitting" off the two phones of the stereo headset by using a standard three-conductor stereo jack and coming from it with two lengths of two-conductor speaker wire ... to each of the receiver's headphone outputs. This works only if both receivers share a common ground point and if one side of their headphone outputs is not "above" ground (which is usually the case). See **Fig. 1** for a basic drawing depicting this idea.*

The old hobby knife trick!

From Phil Salas AD5X: "Here's a quick tip to remember the next time you need to cut out any type of large hole in a plastic project box. I use a hobby knife (like the X-Acto™), heated with my normal bench soldering iron.

"Tin the upper part of the knife blade (the part that's closest to the handle) with some solder, then hold your soldering iron on this tinned spot as you carefully cut the plastic. Always carefully predraw the figure that you want to cut. Scribing it with a sharp metal scribe will also help to keep you

on track for the final removal cuts. It's actually pretty easy to do after you've practiced with it once or twice on a piece of scrap plastic. You can cut round meter holes or even rectangular LCD display cutouts using the heated knife method, once you've developed a feel for what it's like."

Moderator's note: It's also best to use the type of hobby knife handle that's insulated with a cushioned rubber covering, to prevent burns from those calories conducted up the handle from the heated blade. If your X-Acto handle is of the bare metal variety, however, you can slip some large-diameter cable insulation over the handle instead ... try using the outer insulation from RG-8/U.

Improved linear amp input circuitry

From Rich Measures AG6K: You may remember from May's column that Rich suggested a method of more closely matching your transceiver's output drive level to your amplifier's maximum linear input drive level (the maximum RF drive level that should be fed into your linear if you expect to keep it linear). Rich explained how to determine the value of an RF input "pad" and then how to install this pad in series between the amplifier's input coupling capacitor and the amplifier tube's cathode. The following quote is from Rich's suggestion:

"If you look at the specs for today's popular amplifier-tube crop, you'll find that the bulk of the new ceramic triodes require anywhere from 22 watts to 75 watts input RF for full output—anything beyond that results in saturation drive (distorted audio). Yet how many popular transceivers are rated in the 22 to 75 watt range?"

Here Rich continues with another note on the subject and some additional worthwhile information on improving the SWR for your linear amplifier's input tuned circuit: "When I first installed a series/parallel resistance combination in-line with the RF drive feed in a commercially-available amateur HF amplifier using a single 3-500Z tube in a grounded-grid configuration (see the May 1997 column), I experienced a better SWR match on some bands and a slightly degraded SWR on others. This variation was added in the direction that the original input matching circuits were off to begin with. In other words, if the input matching circuit's impedance was too low to start with, the additional 20 ohms of resistance in the amplifier tube's cathode actually improved the SWR match, but if the original input impedance was too high, the SWR degraded.

"The answer, of course, is to achieve a better match on the amplifier's input via the amp's input tuning network, and this brings up another interesting point that a lot of hams tend to miss: The actual impedance transformation of a pi-network tuned circuit cannot be optimally altered without changing at least two of the three pi-network components, yet most commercial amplifiers allow you to change only one.

"**Fig. 2** shows how the input matching circuits of most commercially made amplifiers are configured. A slug-tuned coil adjustment (if that's what your amplifier's tuned input circuit uses as the variable element) will rarely deliver the lowest possible SWR when tuned just by itself! Although it will indeed move the resonant frequency of the network, which will change the indicated SWR, the final SWR may not be the lowest level possible because only one element in the pi-network has been varied. Anyone who has experimented much with his linear's tuned input circuit has probably made this discovery for himself.

"What's the answer? One of the fixed capacitors in the pi-network should also be varied ... and that's not as tough as it sounds. It's usually very easy to temporarily parallel one of the tuned circuit capacitors with a compression-mica trimmer variable capacitor. You can then alternately adjust the slug-tuned coil and the trimmer until the input SWR has been minimized (it should now end up being close to 1:1 at some point in any selected band). If, by chance, there's already too much capacitance in the network, then of course one of the fixed capacitors will have to be disconnected temporarily from the pi-network and a trimmer of approximately the correct value used in place of it. Once an optimum value has indeed been reached, the variable trimmer can be carefully removed, measured and a new fixed capacitor (or parallel combination of fixed capacitors) installed in its place.

"Now, as a final touch, reduce the value of the pi-network's variable inductance, just slightly, by backing out the slug a little bit from its optimal point. This technique will raise the 'Q' of the circuit somewhat; I've found that most solid-state transceivers prefer a somewhat higher 'Q' for best performance. Eimac (the well-known amplifier tube manufacturer) recommends using a 'Q' of 2 for grounded-grid amplifier tuned circuits, though in fact many amplifier manufacturers design for a 'Q' of 1. This too results in less than optimum SWR from the tuned input circuit.

"The above procedure will have to be used for each of the tuned input circuits in the amplifier, usually five or six bands. Take your time when you take on this project, and make notes at each step along the way to answer any questions that may come up at a later time."

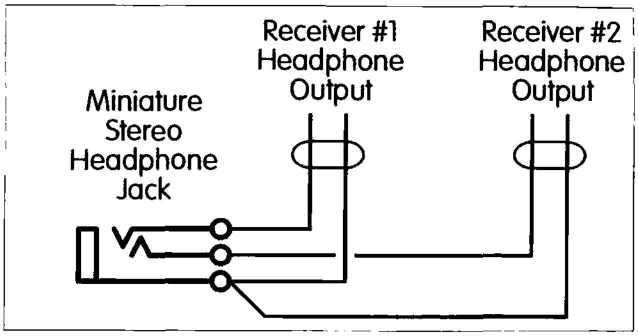


Fig. 1. Wiring of stereo headphone adapter for dual satellite receiver reception.

Moderator's note: Rich brings up a very valid point. You wouldn't expect to be able to a achieve a nearly perfect match on the output of your linear if only one of the pi-network components was variable, so why would we expect any more from the input matching circuit? Making at least two of the components in the network variable makes good sense. A variety of small variable trimmer capacitors, in the general range of 2 pF to 180 pF, can be obtained from some of 73's advertisers, including All Electronics [(800) 826-5432)]; Fair Radio Sales [(419) 227-6573]; and others.

Murphy's Corollary: Whenever a specialized defective part has been positively located, it will be the only one that is not mentioned anywhere on the manufacturer's "Complete Parts List".

By the way, if you need data on a specialized part, try looking on the Internet under the part manufacturer's Web page. Many parts manufacturers now have datasheets available for downloading via the Internet. This makes it much quicker, in most cases, to obtain needed information than writing or calling the

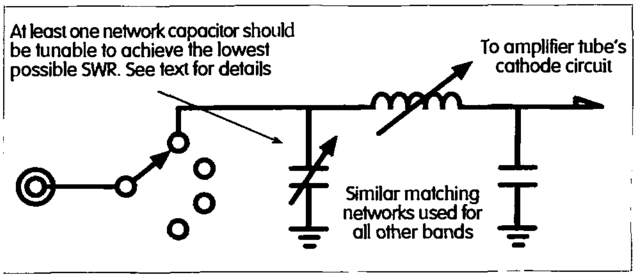


Fig. 2. Typical pi-network used for input matching in a commercial amateur linear amplifier.

Number 56 on your Feedback card

THE DIGITAL PORT

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703
[jheller@sierra.net]

The BayPac™ adventure

I have received a number of inquiries about the BayPac modems, so I will devote this month's column to my experiences with the new BP-2M multimode. Having heard numerous good reports, I wanted a firsthand experience.

Good info on the Web

The hardware is very compact because the system is software dependent. I checked out the various sites on the Internet and found there is a Web site originating in Bavaria which is the birthplace of Baycom. The Bavarian Packet Radio Group [www.baycom.de/] is actively pursuing new developments in packet design. The Web site displays their new 9600 bps modem schematic for the avid builder.

TigerTronics has a very informative commercial Web page [www.tigertronics.com] that lists many of the programs available for the BP-2 and BP-2M and has some of them ready for download.

I called their toll-free number (after clearing the purchase with the wife), asked a few questions about software and gave them my order. The salesperson was very courteous, even to the point that she promised shipping in time to fit my schedule. This is being written during a 1600-mile round trip to Washington state to see our youngest son's family and inspect the newest grandson.

The timing was so close that it looked as though the promised arrival date was about to come and go, so I called TigerTronics to confirm shipping and got the UPS tracking number. Upon entering that number in the UPS Web page I found the package was in the area—and sure enough, the truck pulled up about 15 minutes later. Patience is one of those virtues I am working on (a little haphazardly, but it's coming along).

The next day we started on our big adventure, and as my wife drove, I read the installation disk in my laptop. The README.DOC text was informative. However the *.EXE files wouldn't load. There was an error displayed on the screen that indicated corrupted files.

An hour or so later, we were driving through Grant's Pass, Oregon, the home of TigerTronics, so I gave them a call on the landline. I talked to a pleasant tech person and he informed me that if the files were corrupted that would be a first, but I could download fresh files from the Internet on their Web page.

Very picky DOS format

That was fine, the least of several inconvenient choices: I decided I would do that when we reached Washington. Then ... my mind started running through bits of information I had stored there from their literature. One piece said the program would not run with Windows© running, not even from a DOS window and that was what I was using, not realizing the install program was included in that category.

I fired up the laptop in DOS mode, told it to install from the floppy and voilà! Success. I spent the next few hours reading BayPac instructions from the screen (I hate to use the little portable printer with the car under way).

Wiring is easier

Before I left home I found the wiring for connecting the Icom W2A to a regular everyday TNC. I wanted to hook up the BP-2M while in Bremerton and amaze my offspring engineer whiz. So I was prepared ... I thought. One of the differences when using BayPac is that they have included extra circuitry in the modem that allows it to key most handhelds without adding any resistors or capacitors in the cable. This is made clear in the HINTS.DOC included on the disk.

Now I was really armed and ready for action. I still had to wait for several hours for Washington to appear over the horizon, then get the simple wiring out of the way the next day, find the local PBBSs and really impress friends and family.

In the meantime (it's always good to have a little delay to justify reading the documentation), I checked several of the other text files. In all, I counted eight of them, and they are all well-written and understandable. The files covered everything from mating components and basic operating techniques to the advanced features available with my new toy.

I experienced the dreaded little hitch after hooking up the new packet station. It would neither receive nor transmit. The BP-2M comes with a neat little program, BPMODE.EXE, that will search all the Comm ports to detect the modem. Once it has performed this function, you can select the mode you wish to use and make necessary tests and adjustments.

When I ran BPMODE my IBM Thinkpad™ 365XD appeared unable to find either Comm port #1 or #2 regardless of what I wrote into the SCC.INI file. I read through the long documentation that came with the software and found a wealth of wonderful things I was going to do with this modem if I could just get the software to converse with a serial port.

Some combinations don't work

There was a clue that I might be fighting a losing battle with this combination. Or at least until I could find someone who has a work-around for the problem. The clue is that there are some laptops that just couldn't be made to work with the software. The named laptops did not include mine but that may be included now because the documentation was written before my laptop was on the market. Ah ... to be on the cutting edge!

This problem did put a damper on the big demonstration, but it made me think. One thought was that I have a strictly DOS machine sitting home (800 miles away).

manufacturer directly. Use one of the many search engines (such as Yahoo™, Web Crawler™, Alta Vista™, or others) to find what you're looking for if you don't have an exact address. And while you're browsing the Internet, be sure to check out the "Ham to Ham" column's home page on the World Wide Web at [http://www.rrsta.com/hth].

As always, many thanks to this month's contributors, including:

Frank Brumbaugh W4LJD
P.O. Box 30
c/o Defendini
Salinas PR 00751

Thomas M. Hart AD1B
54 Hermaine Avenue
Dedham MA 02026

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

Richard L. Measures AG6K
6455 La Cumbre Road
Somis CA 93066

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73 Magazine, *and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or* 73 Magazine *for any equipment damage or malfunction resulting from information supplied in this column.*

Please send all correspondence relating to this column to its moderator at the address at top. All contributions used will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73 Magazine*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73 Magazine*.

The other was that the TigerTronics Web site has a Windows shareware program available for download. Both ideas offered possible excellent solutions.

The deciding factor was that I had overspent my allotted hamming time for a visit that did not have extra time, so the solution would have to wait until my return home in a few days. It takes a supreme application of patience to sacrifice valuable ham time.

We made our way home; I had several catch-up projects in the mill. I got on those and downloaded the Windows program and let that sit for a day as I was still running a little behind.

The program, WINTNC11F, by Jon Welch G7JJF, proves to be a well written piece of shareware, but it only helped in that I could now say I had my hands on a Windows program that can be used with the BP-2M. This, however, wasn't helping the immediate problem.

Serial cable problem?

The old faithful 386 DOS machine surprised me by not finding the BP-2M when it was in place on the Comm port and the BPMODE program was searching for it. Obviously, to me, there had to be a cable problem with two adapters in place. Perhaps the wiring was taking a wrong turn in there?

After some experimenting, the BP-2M was installed on the Pentium desktop which has a 25-pin serial connector and suddenly, the room lit up with smiles as the computer spoke to the BP-2M in fluent computerese. That surely proved the problem was in the 9-pin to 25-pin lash-up I was using.

However, a new, one-piece adapter cable still wasn't the answer, so I called TigerTronics. After some discussion, the knowledgeable tech offered an idea I had overlooked. The 9-pin serial port for the mouse on the computer that was friendly to the BP-2M could be used to check the connection through the new cable to the modem.

It was necessary to restart the computer and not allow Windows 95 to start so a no-frills DOS could be accessed before the operating system started hunting for the mouse. With this hook-up, the BP-2M came to life through the new cable.

Further discussion revealed there are some 386s that cause this kind of grief. I am more concerned about the laptop. That is the desired home for the tiny BP-2M. Fortunately, the laptop is under warranty and IBM has a help line. I will get those two devices mated for portable packet work.

The BP-2M is quite a marvel. It looks to be about 1/20th the size by volume of the MFJ-1274 when it sits next to it. With it hastily mated to the Icom W2A and the signal fed to the roof-mounted yagi, the connection to the local PBBS is flawless. The BayPac packet software resembles most other DOS communications programs on the screen.

Plenty of good info at the fingertips

The diminutive system is capable of acting as a digipeater, offers file transfer and can handle up to eight ports open at once. With the 60-page operator's manual at hand, there is very little that cannot be accomplished with the BP-2M. It will certainly hold its own in packet operation.

Included in the package is a shareware multi-mode package, HamCom, designed to operate the BP-2M in AMTOR, RTTY and CW as advertised. I loaded the software and it has some very nice features that look like a fairly user friendly package. I will make a cable for the HF rig and give that a try when the dust settles from this last escapade.

Serial cable notes

Looking back on the cable activity, there are a few items I will pass along. There are of course, standards when adapting the 9-pin serial port to the 25-pin connector. Apparently, I was in too big a hurry to read all my tests accurately or I would have realized the adapters were not at fault. Although the TigerTronics tech advised me these adapters are always suspect and this was his first area of questioning. He advised that even when they check right, some have been known to leak between pins.

It takes some careful inspection of the cables and sockets to note the designated numbers on the pins before checking the connections through the cable with an ohmmeter. The BP-2M requires six of the available connections. Other modems and TNCs have differing requirements. For instance, the AEA PK232 needs all nine of them to function properly.

There are some packet modems that will get by with fewer than six. It is apparent there is no real need for the 25-pin connector for our needs. I see some listings on 25-pin to 25-pin serial cables for twelve wires. Though they are always available somewhere, I will include the proper 9- to 25-pin connections for your future reference (**Table 1**). When problems arise, it is one more place to check.

The digital world offers a lot of challenges. As you can tell, I spent more time on this project than I had allotted and it is still not finished. The laptop will need some help, but I am confident there will soon be one more portable packet station and of course there is the HF capability I have not yet explored. There's something special about new ham gear in the shack and overcoming the challenges it can present just make it that much more so.

If you have questions or comments about this column, E-mail me at [jheller@sierra.net] and/or CompuServe [72130,1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line [KB7NO@N7NPB.#NONEV.NV.USA.NOAM]. For now, 73, Jack KB7NO.

DB 9	DB 25
PIN 3	PIN 2
2	3
7	4
8	5
6	6
5	7
1	8
4	20
9	22

***Table 1.** Adapter pin-out.*

LETTERS

Continued from page 7

dengue fever and malaria. Anything that's on the side of the angels we want! It's difficult to get all the parts here but I managed to build a Bioelectrifier and my wife and I use it for 20 minutes each day as a prophylactic.

We are leaving here at the end of May to cruise Venezuela and points west. If we can get through the next six months without any tropical diseases I will consider it successful.

I thought your editorial was great—gold dust. We have been living that way for several years now—ever since I found out that old age wasn't something that happens with the passage of time; rather it is what you do to yourself by living wrongly.

Every word you say is true—keep saying it, even if only the more aware take notice. Far better to share the planet with them: the rest of the population will probably be watching TV anyway. Keep up the good work.

You might want to go to an hour a day when you think your blood is in trouble with a virus, parasite, etc. Hey, sailing around is a nice way to mark time through life, but what are you going to do to leave a little more of a mark than that on the sands of time? How about a traveler's newsletter about the places you've visited—the better inexpensive hotels, restaurants, etc.? You don't have to do the research, just ask the local hams and write that up. Who would know better? What kind of stuff should tourists look to buy that's special in that area? What is there to do? Scuba diving? Horseback riding? Fishing? What else? I'd be interested in a report on the hams on each of the islands—what bands they're on, how difficult is it for a visitor to get a license, are any of the local hams interested in letting visitors use their stations for a day or two while visiting the island? Any ham clubs? When do they meet? Any islands with 2m repeaters? ... Wayne.

Number 58 on your Feedback card

On the Go

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

Back to school

As we approach September, school looms for many amateurs. Some are returning to the classroom themselves, while for others it's their children who are headed to school. This presents a number of ham-related opportunities and challenges.

Many college students return to campus and get set up in their dormitory (excuse me, residence hall) rooms. Some will wish to set up at least a small ham station, if that is permitted by the university. This could be as simple as a charging station and the handie-talkie, or something more comprehensive. The challenges faced in these situations are also faced by those who travel and wish to operate from a hotel room, and even for many who live in apartment complexes.

The first issue is power; most multi-unit facilities are woefully under-equipped with power outlets. Many dorm rooms, for example, were designed in the days when a student brought a reading lamp and an AM radio and two or three outlets were more than adequate.

Second is the radio frequency interference problem. When many people are sharing a common building, there is the very real chance that an appliance in the next room will interfere with many amateur frequencies. Hair dryers, for example, can sometimes create the most annoying sounds throughout the spectrum. Likewise, there is the potential for intermodulation interference if wireless phones are located throughout the building. Of special concern, especially in hotels, is the cable television service. Many cable systems utilize the two meter ham band frequencies. In theory, this creates no interference because the cable operators are required to keep their signals shielded. Unfortunately, as cable systems age, and as connectors loosen, the shielding becomes less reliable. In such cases, a two-meter handie-talkie can create a herringbone pattern on many of the televisions in the system. Although the cable system is at fault, the emphasis will be on eliminating the transmission rather than fixing the cable system.

Third, we all know a good ground is essential, especially if you plan to operate in the high-frequency range. However, unless you are located on the ground floor, the usual options, such as a cold water pipe, can create more problems than they solve. If the length of the pipe before it reaches an earth ground is a quarter wavelength or an odd multiple of a quarter wavelength, you will have RF hot spots at the rig.

Finally, there are the problems associated with an antenna, particularly if your intent is to operate in the HF frequencies. A proper antenna is big, clearly visible and out in the open, most of which are frowned on in temporary living accommodations.

Does this mean that you need to leave your hobby at home or in the car for the duration of your stay? Not necessarily, although successful operation may require a bit more ingenuity. First, plan to operate at relatively low power. This is not only practical, and good operating practice—it is also the law. A power strip (with its own circuit breaker, please) will help solve the electric outlet shortage problem, but don't forget that the available current may be less than 20 amps shared among several rooms.

Grounding can be accomplished in any number of ways. It is possible to cut a wire to tune the ground. Using a quarter-wave wire attached to the grounding post on the antenna tuner can alleviate this problem from a radio frequency ground perspective. To figure the length of the required radial, use the following formula:

The length of the radial in feet = 234 divided by the operating frequency in MHz.

For 20 meters, for example, the radial would be approximately 16 feet long. Don't forget this is an RF ground; you will still need a DC ground to prevent electrical shocks. This may be accomplished by a three-prong electrical plug if the transceiver has an internal power supply. If not, you can try attaching a wire to the center screw on the electrical outlet plate on the wall or a cold water pipe. Also, treat the radial as hot and keep it located so it can't accidentally come into contact with a person or heat up something flammable such as the carpet.

Many large apartment complexes, hotels and dormitories have steel frames. The bad news is that this blocks RF signals. The good news is *also* that it blocks RF signals. If you can get your antenna outside the window, your signal to the outside world will be better, and your signal to the other occupants of the building will be attenuated. For two meters, a J-Pole outside the building will normally be relatively unnoticeable while providing reasonable performance. For HF, wire antennas may be more appropriate. Don't automatically assume that your antenna must be of the stealth variety. It may be possible to get permission to install a small antenna on the roof of the building. A single-band vertical designed for mobile use with several quarter wave radials on a balcony or a dipole on the roof can provide acceptable results. Diplomacy and courtesy will go far in getting permission, if this is possible. Incidentally, I once spent months in a small apartment while on active duty for the Gulf War. My schedule was such that I really didn't have time to operate, although after getting off duty I wanted to listen to various broadcast and aircraft frequencies in the Middle East. I realized that the two-story building where I lived had an eaves trough which fed three downspouts. None of the metal touched the Earth. By connecting my rig to one downspout by means of very fine magnet wire, I was able to listen to the action unfold in real time. I was not comfortable using it as a transmitting antenna but it did a great job of receiving.

Finally, remember the cardinal rule of operating. When in doubt, filter, filter, filter. For HF operating, use a low-pass filter. If you are operating in a narrow band of frequencies, a band-pass filter may be appropriate. Your own television is probably closest to the transmitter and is most likely to pick up any RFI, so a high-pass filter on the cable in your room may be a big help. Just make sure that disconnecting the cable from the television doesn't set off a theft alarm at the front desk.

Feedback

I have enjoyed the response I've received on my first couple of columns. We hams are indeed communicators, and I've gotten messages via radiogram and E-mail as well as "snail mail." Ed Geis WB8IOE/4 shared an interesting idea, as we head into football season. When he was in the Dayton area, the Miami Valley FM Association would share scores from the various high school football games in the area. This information would be passed to the announcers who would read the latest score from a game being played elsewhere. Ed said this kept the hams in practice under conditions of noise, bad weather, etc. It also gave good public relations to the hobby since the announcer would point out that this information was being provided via amateur radio. Thanks, Ed.

In the future, I am planning a column devoted to many of the ideas that you have sent because some have been very interesting. 73

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153
[ajr@ari.net]

At the beginning of the summer, I highlighted a book published by Joerg Klingenfuss that helped the connected ham get information. Now, with Labor Day here already, Joerg has another offering for us.

Whether or not you think it's important, weather plays an integral role in our daily lives. Hams active on HF need to know about the ionosphere, and hams active in the community want information directly, without having to turn to the weathercaster on Channel 88.

The *Klingenfuss 1997/1998 Guide To Worldwide Weather Services* presents information on weather information available via a variety of radio modes, as well as the Internet, that is sufficient to satiate the worst weather junkie.

Within its over 400 pages, this 17th edition of the classic weather guide covers the spectrum of educational sites, such as the Automated Weather Source at [http://aws.com/], which sets up weather stations at schools throughout the United States; through countrywide sites like Macom, at [http://weather.macom.co.il/], which gives weather information for Israel and satellite photos of the Middle East; all the way to sites like the Climate Diagnostics Center, at [http://www.cdc.noaa/gov/], which is devoted to monitoring fluctuations of global and regional climate.

Besides covering the Internet, which is rapidly becoming the primary site for information interchange, the book also gives frequency and schedule information for a variety of Navtex, Radiofax, and Radiotelex sites worldwide. There are even crop calendars and jet stream data in this book.

With a total of 181 Internet sites, 110 Navtex stations, 64 Radiofax stations with schedules, and 91 Radiotelex stations, this comprehensive new compilation is a must-have for anyone interested in the latest weather information. It is available from Klingenfuss Publications for DEM60 (about US $36). You can write them at Hagenloher Str. 14, D-72070 Tuebingen, Germany; or visit the Internet site at [http://ourworld.compuserve.com/homepages/Klingenfuss/]. Whatever you do, don't forget to tell Joerg and company that you read about it here in RTTY Loop!

And speaking of high tech, I received a note from Buck Kidd W7LV/VQ9EK, who says he came across a Teletype Model 43 at a yard sale. Trying not to laugh, he found it's clean and it works. However, he needs one of the plastic paper guide bars which separate the incoming and outgoing paper streams. Typetronics, in Fort Lauderdale, used to carry all the parts a normal person could want ... even parts for his 35 RO, but there is no current telephone number available.

Well, gang, can anyone out there help Buck? If so, pass it along to me and I'll do my best to let him know.

On a more modern note, I often receive requests for a program to work with this or that terminal unit. This month, I would like to look at the latest offerings from Gary Johnson KF7XP, and his XPWare line. For DOS users, Gary has the following programs.

XPCOM Version 1.60: XPCOM is designed to support the PK88, PK232 and MFJ-278. For the AEA TNCs, all operations are performed in Host Mode.

XPDUAL Version 1.60: XPDUAL is specifically designed to allow dual port operation with the PK900 and DSP2232. Allows either full or split screen operation.

XPKAM Version 1.60: XPKAM Version 1.60 now supports version 8.0 firmware for the KAM and KAM+ and adds support for the KPC9612. Program supports the KAM, KAM+, KPC3, and KPC9612.

XPPTC Version 1.60: XPPTC is designed to work with the Paccomm PTC, SCS PTC and SCS PTCPlus. Requires version 2.0 or higher firmware.

XPPCI Version 1.60: XPPCI is designed to work with the HAL P38, PCI4000M, and DSP-4000 controllers. Supports all available modes. Also supports bi-directional binary file transfers in the background.

If that's not enough, check out his new Windows™ version, *XPWare for Windows (XPWIN) Version 1.1.8*. In Gary's words, XPWare for Windows is the latest program in the series. It offers support for AEA, Kantronics, SCS/Paccomm (PTC, PTC-Plus and PTC-II), and Hal (P38, PCI4000M, and DSP-4100) controllers. One program supports all controllers and the user may run one or two controllers at the same time (may be different types and brands). All controllers are run in their native host modes; this allows the most flexibility in the program.

The program also offers full transceiver control for most of today's HF radios. These include all Kenwood, ICOM, and Yaesu (FT-767, FT-840, FT-890, FT-900, FT-990, FT-1000 and FT-1000MP). The transceiver control section offers user-definable memories, scanning, quick store and recall of frequencies, band changes, etc. This is probably the most powerful transceiver interface in a program primarily designed for TNC control.

The program also supports DX Cluster monitoring. This allows the user to link to the cluster and, when a DX spot is received, the program will announce the callsign and frequency through a sound card (if installed). It also allows the user to "point and click" to the DX frequency (if transceiver interface is configured).

Full ANSI support is included, as well as a full host of new features that were not included in the earlier XPWare DOS program.

Among some of those features are Binary File Transfer capability including YAPP protocol for Packet, Restartable Binary File Transfer Protocol for Clover (PCC-compatible format), Restartable Binary File Transfer Protocol for GTOR and PACTOR, Automatic or Prompted Reception of Files, and Multiple Transmit File Queues.

All of this is yours to see via Gary's page, located at: [http://www.goodnet.com/~gjohnson/] or via the link on the RTTY Loop Home Page. The nice thing about this software is that it is classic shareware: Try it before you buy it. Full registration cost is $80; users of previous versions pay much less.

Finally this month, let's return to a recurring question. Mark C. Wilke, writes:

"A friend of mine recently bought a used AEA CP-1 at a local swap. We've been trying get it to work with HamComm with no luck. I wonder if you have any idea if there is something special we'd need to do to get HamComm to work with the CP-1 (the CP-1 has got the optional RS-232 interface) or is there something else we should be using. I saw the program called 'TUWIN' in collection #4 of your files. Perhaps that is what we should be using.

"Sure would appreciate any assistance you could give us. With AEA being unavailable to contact at this time, we can't even try them for the original software they offered."

Well, Mark, the bottom line on the CP-1 is that you can use it. Here's some other information, recently received, which should help you as well. Robert Creason passes along this information on the CP-1:

"Most of the AEA CP-1 and CP-100 TUs were shipped with only the C-64 interface installed. There was an optional kit sold by AEA for the standard RS-232 I/O. The manual shows the schematic of the circuit required for this RS-232 interface. The connector hole is already in the cabinet, and the PC board is etched for the ICs and other parts. I have installed one of the circuits in a CP-100 I once had and traded off

HAMSATS

Number 60 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

Delays, delays ...

The wait for amateur radio's most ambitious satellite to date, Phase-3D, continues. Since the failure of the Ariane 501 booster last year, launch delays for the Ariane 502 flight have been numerous. P3D is ready, but nothing can be done till ESA, the European Space Agency, says go. ESA cannot afford another failure with the new Ariane 5 booster, and AMSAT groups around the world prefer a methodical, safe approach to the launch campaign. There is only one Phase-3D, and it is not insured. After insertion into orbit, the satellite will receive an OSCAR (Orbiting Satellite Carrying Amateur Radio) designator.

In the meantime, while we patiently (?) wait for P3D to be launched, there are many things to be done. The new satellite has frequencies and modes never seen on previous amateur radio spacecraft. While a well-equipped home station configured for the current hamsats will be ready for some facets of P3D, improvements and upgrades are needed to address the new features.

AMSAT, the Radio Amateur Satellite Corporation, has taken the initiative to develop publications to try to answer questions from both the experienced satellite enthusiasts and the newcomers. Two of the best are *P3G to P3D (The Provisional Preliminary Pre-Flight Guide to Phase-3D)*, edited by Paul J. Beckmann WAØRSE, and *Working the Easy Sats* by Gary B. Rogers WA4YMZ. Both are available at reasonable cost from AMSAT. The phone number is (301) 589-6062. If you have questions about prices or availability, just ask Martha at the AMSAT number, or send E-mail to martha@amsat.org.

P3G to P3D

The *Provisional Preliminary Pre-Flight Guide to Phase-3D*, or just *P3G to P3D*, is a first attempt to create a user's guide for a satellite that has yet to be launched. The first edition was published in April 1997, and contains up-to-date information.

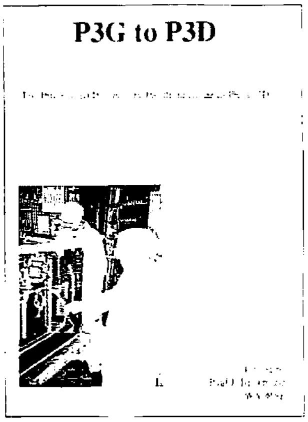
At the urging of AMSAT Executive Vice-President Keith Baker KB1SF, Paul Beckmann WAØRSE has collected articles and information about Phase-3D, augmented them with his own material and presented the compilation in a single volume. At just over 60 pages, this magazine-format offering provides all the basic information that a future Phase-3D user might need to begin planning and construction of a functional Earth station, and it's all in one volume.

Paul begins the book with a foreword and an introductory article explaining the guide's purpose, and providing the reader with some history to set the stage for the articles that follow. Other material by author/editor Paul provides the "glue" between the larger technical topics.

The first major article, "Phase-3D—A New Era for Amateur Radio" is packed with data about the satellite, its radio gear, the computer system, GPS (Global Positioning System) experiment, the Japanese SCOPE cameras, the power collection and distribution design, attitude control, propulsion units, space frame and thermal control. This submission from the Phase-3D Design Team, with its figures and tables, is a valuable overview of the spacecraft's components and functionality. While giving many general descriptions, the article also provides details down to exact frequency bandplans and expected receiver sensitivities and transmitter radiated-power figures.

Paul follows with two short features on the modes of Phase-3D and the use of computers in the shack. This leads into a detailed description of possible ground station equipment for use with the new satellite. Due to the higher frequencies that will be prevalent onboard Phase-3D, Paul provides ideas on the use of remote transmit and receive converters that can be mounted close to the antennas to minimize feedline loss.

The center section of *P3G to P3D* is a collection of photos and information tables covering the specifications and appearance of



all the major transmitters and receivers in the spacecraft. Among the many novel experimental radios on Phase-3D is a receiver with an analog passband between 21.21 and 21.25 MHz built by Matjas Vidmar S53MV. Other bands covered include 145 MHz, 435 MHz, 1.26 GHz, 2.4 GHz, 5.65 GHz, 10.45 GHz and 24.048 GHz. Some bands have both transmitters and receivers, while others are specifically for uplink or downlink only.

Ed Krome KA9LNV has been active on the satellites for many years, primarily with home-brew gear. His article "The View from Below: Thoughts on Phase-3D Ground Station Requirements" goes a step further with plans for innovative stations for those interested in setting up a system for Phase-3D access. Ed's focus is on project ideas for home construction of antennas and commercial surplus radio conversions that can be pressed into service for the microwave transponders of Phase-3D. His own antenna system for every Phase-3D mode from 435 MHz up through 24 GHz fits on a single rotatable seven-foot boom.

Another ground station article from Frank Sperber DL6DBN provides the European point of view toward satellite modes and equipment choices. Frank adds information about the digital modes, link-margin calculations for the different bands and possibilities for transponder combinations. He points out that it is feasible to link the 21 MHz receiver to the 24 GHz transmitter, or anything else in between. It is also viable to activate multiple

---

(much to my regret)! However, I understand that the ICs required are no longer made now. The P/Ns are given in the manual. Might find some at one of the big hamfests. There are other ICs made now that can be used but would require a small PC board mounted inside the cabinet. This is a rather simple mod—almost anyone should be able to do it."

(I covered the modification in a previous issue of RTTY Loop; it is available on the Web home page for your benefit.)

Robert also passes along a few other points worth sharing. About the S/W for the Hal ST6000: "I have been using a program called BMK-MULTY that will work with most all the old TUs. The manual shows the hookup for the ST6000. I have used it with the CP-100 and now with an old AEA ATU-1000. It's the very best program for RTTY, AMTOR, PACTOR and CW that I have had, and it will give you SSTV also. It is sold by Schnedler Systems, P.O. Box 5964, Asheville NC 28813."

(I reviewed an early version of BMK software many years ago. I was impressed with it then, and I presume it has continued to grow over the years. Would be interested in others' experiences with this program.)

Well, as I mentioned above, the RTTY Loop home page continues to be a valuable resource for the radio amateur—both for the information it contains and the links it provides. As of this writing, we have had more than 10,000 visitors to the page. Check it out at: [http://www2.ari.net/ajr/recs/]. I look forward to your input, which has kept me going all these years. See you next month in the RTTY Loop!

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Dayton Youth Forum '97

It was another terrific turnout at the HamVention Youth Forum this year. It's just so encouraging to see large numbers of adult hams come indoors on what was a beautiful day, to show their support for the youngsters. A big audience filled with supportive folks means a lot to all the children who do presentations at the convention.

With a great deal of behind the scenes machinations and lots of cooperation from the DARA people, we managed to pull off a really big surprise to open the forum. Ron Parese WA4SIR, one of the SAREX astronauts was brought to the Youth Forum as a big surprise to the audience.

Ron delighted the kids and adults in the audience by describing how he became involved in the space program and what it was like to be weightless. He spoke about the SAREX program, which is designed to encourage children to get interested in space science. As often happens in my own classroom when an astronaut is on the radio, many of the kids get nervous and forget their questions. But after a few moments everyone joined in the fun. What a treat for children to be able to ask questions of someone who has actually been in space. It was a great experience to have Ron speak with the audience for more than 20 minutes. I'm sure the kids will enjoy going home and telling their friends about it.

Photo A. SAREX astronaut Ron Parese WA4SIR, shown here with young forum speakers, was a surprise at the Youth Forum. Photo courtesy of Jim Ries WX8F, Dayton Amateur Radio Association.

My first young speaker was Mathew Karl KG2HV, age 12, an Extra Class ticket holder from New Hyde Park, New York. Mat belongs to LIMARC (Long Island Mobile Amateur Radio Club), whose large membership sponsors a Junior Operators division.

Continued on page 62

receivers with a single transmitter, or even multiple receivers to multiple transmitters if the satellite's power budget can take the load.

Paul finishes his guidebook to P3D with more data on the SCOPE cameras, a detailed bibliography for further research, a pictorial view of the satellite's orbit, a map of the Earth showing the origination points of the satellite's components and even a template for a fun, fold-up paper model of the largest, most ambitious hamsat ever, Phase-3D.

Working the Easy Sats

For newcomers to the amateur satellite program, the thought of building microwave gear to communicate through satellites thousands of miles out in space may seem daunting. For those that have been chasing the hamsats for many years, it's just another logical step and *P3G to P3D* is the key to moving on to new challenges. But when Phase-3D becomes operational, there will be many hams who would like to try their hand at space communications via the new satellite who have never listened for, or transmitted through, an amateur satellite.

When AMSAT-OSCAR-6 achieved orbit a quarter century ago, Mode "A" (two meters up and 10 meters down) seemed hard. Satellite tracking was not done with computers, and two-meter all-mode gear was mostly for experimenters and dedicated VHF enthusiasts. Today this mode is considered an entry point to hamsat operation.

Gary Rogers WA4YMZ has updated his popular 28-page booklet (stapled, 8.5" x 11" format) with contemporary information as of April 1997 (Revision 3.2). The publication details knowledge Gary has learned while setting up and operating his LEO (low-Earth orbit) satellite station. He says, "I did it. You can too. Come join the fun!" You may already have all the gear and antennas needed to listen for Dove-OSCAR-17 on two meters, make HF contacts through RS-12, talk to the cosmonauts on *Mir* with your two-meter FM mobile rig or work stations via the 70-cm FM repeater on *Mir*.

Gary's definition of an "easy sat" is a hamsat that is easy to hear, needs only simple ground station antennas and is easy on the finances. The book begins with a detailed table of contents, an introduction and an excellent frequency chart with operational notes of all the current amateur radio satellites. A glossary section follows, to illuminate all the acronyms associated with hamsat space communications.

The book continues with an explanation of the differences between amateur space communications and terrestrial activities. This section, titled "Special Considerations," addresses how to work through analog transponders, deal with Doppler, choose antennas and track the satellites.

With all the preliminary information out of the way, detailed narratives follow on all the "easy sats": RS-10/11, RS-12/13, RS-15, Dove-OSCAR-17, Fuji-OSCAR-20, Fuji-OSCAR-29, AMRAD-OSCAR-27, *Mir*/SAFEX and the Shuttle's SAREX.

For those who would like to get ready for Phase-3D, but haven't worked the current fleet of hamsats, this is the place to start. Gary's information on the pursuit of the "easy sats" is accurate and carefully compiled. A newcomer armed with this manual should have no trouble getting a good beginning with this technology-oriented facet of ham radio.

The work concludes with thoughts on the digital satellites, Mode "B" (70 cm up and two meters down) on AMSAT-OSCAR-10, automatic tracking and tuning controllers, QSL cards, grid squares, certificates, a bibliography, AMSAT information and a complete description of Gary's home station.

Get both

The newcomer to amateur satellites needs to begin the hamsat quest with *Working the Easy Sats*. Even an experienced VHF/UHF enthusiast will have many questions about space communications when it comes time to actually make a contact via satellite. This book will answer them. With the pursuit of the "easy sats" complete, *P3G to P3D* will continue the process of getting ready for Phase-3D. Neither book will build your station for you, but the authors' insight will provide a map for your own successful configuration. 73

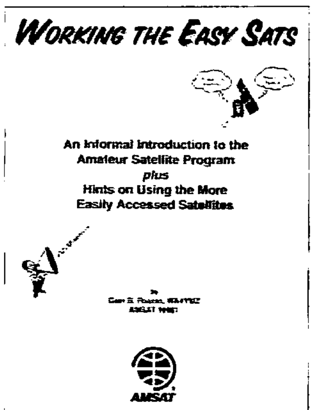


***Photo B.** ARRL Hudson Div. Director Frank Fallon N2FF wishes Mat KG2HV and Carole good luck at the Youth Forum.*

Mathew described the many activities the young people have, including a weekly net that everyone is welcome to join. The youngsters have their own meetings where they plan their activities like a trip to the ARRL where they had a special tour and got to operate the W1AW station.

Mat showed slides of camping trips, bunny hunts, bike rides, and putting up antennas in the wild for contesting. The LIMARC members are to be commended for their tireless work and efforts with young adults in ham radio. If Mathew is an example of the kind of young ham that club is producing, our hobby is in good shape.

Mike Stutske KC8FOU is 14 years old. He spoke about having fun with friends on two meters. Mike had a really nice slide presentation where he showed us all the activities he and his dad do together in ham radio. He is responsible for getting other teen friends into the hobby. They all check in with each other every morning to plan their day.

Mike has also become an official weather spotter. He helps with communications at bike races and enjoys going to local hamfests. Mike feels that he and his dad get to spend lots of quality time together because of their mutual interest in the hobby.

At this point, Maria Harlan KC6ABM, sales support coordinator from Kenwood, came to the forum bearing gifts. She spoke briefly about the Kenwood newsletter that goes to clubs throughout the country. Kenwood has always been supportive of youth in ham radio. She distributed gifts to all the young people in the audience. We all congratulated Maria on getting her Extra Class license before coming to Dayton.

Joseph Von Bokern KBØYWT, age 12, and Nathan Wang KBØUQS, age 16, spoke next as representatives from one of my favorite clubs: BARC Jr., as sponsored by the Boulder Amateur Radio Club in Colorado. Two of the nicest and most talented hams I've ever met are Rip and Ellie Van Winkle, who are responsible for helping to organize and train the youngsters who come to my youth forum every year. The group was sweet enough to present me with a plaque with all the children's names on it who had been presenters at Dayton since 1993. What an impressive group!

Joseph had a terrific slide presentation showing the BARC Juniors having fun with foxhunting. He gave us some good tips about finding the hidden transmitter, and did it all with great humor. His fellow club member Nathan did an excellent job describing slides showing adventures in Field Day and contesting. He described HF night at Ellie and Rip's house where he got to speak with people he knew from other states. Nathan especially likes the way you can meet so many interesting people on the radio. He thinks that showing kids the fun on HF has led many of their club members to getting higher licenses. It's always a pleasure to meet with the young people from this highly productive club. Thanks for everything, Ellie.

It wouldn't seem like my youth forum was complete without the appearance of one of our staunchest supporters—Chris Lougee, National Sales Manager from ICOM. For the last 10 years, ICOM, and Chris, in particular, for most of those years, have been contributors to my youth forums across the country. This year one lucky child in the audience was the winner of an IC-T2A handheld transceiver. Special thanks to Chris and all the nice folks at ICOM.

Kathy Gilliland KBØFDU from Hiawatha, Kansas, is a former speaker from a previous youth forum. She's all grown up now and gave a talk about ham radio and career choices. She herself works for a local radio broadcasting station where she lives. She feels ham radio provided invaluable experience in being comfortable behind a microphone.

Richard Stubbs KC5NSZ from MFJ customer service has been supporting the youth forum for many, many years. He appeared this time with Mr. Jue, the founder of MFJ and Nick Smith from *Amateur Radio Trader*. Nick announced a contest which would begin in the August issue. A cartoon character named Art would go on a DXpedition to several locations. Clues would be given as to where he was. MFJ gave $10,000 in prizes for the contest.

Martin Jue *(seen on this month's cover)* was given a bit of a surprise when my audience stood and sang Happy Birthday to him for the 25th anniversary of MFJ. Congratulations to a fine gentleman! Richard then gave away several nice gifts including a Morse Tutor, a new MFJ product. He donated one to my school. I'll be sure to give my readers a review. Let's remember to support all the manufacturers who are actively lending support to recruitment efforts to get qualified young people into ham radio.

The last presentation was from a talented group of students from Hook Elementary School in Troy, Ohio. They got to speak with astronaut Nancy Decker Curie on the all-Ohioan crew aboard the Discovery telebridge SAREX contact last year. Teachers Ed Latta KA8CBE and John Gibbons KB8OFS introduced Derek Gibbons KB8YTL, Danny Ojeda KB8ZU and Matt Penneybacker KC8BGF, who spoke about their school contact with STS-70. These children's excitement as they described the preparation into teams for the contact, their questions to the shuttle, and their meeting afterwards with Nancy Curie, seemed a fitting ending to a forum which had begun with a visit from an astronaut. Only in ham radio! 73

***Photo C.** The Elmers with Nathan KBØUQS (left) and Joe KBØYWT (right) from Boulder, Colorado.*

NEVER SAY DIE

Continued from page 48

The *Dilbert* books have my laugh ringing through the house. Scott Adams is a genius.

Then there's P. J. O'Rourke, who lives down in the next town here in New Hampshire. Don't miss his books or listening to him talk. Hey, if you catch a talk of his on radio or TV, please tape it and send me a copy so I can enjoy it. Ditto Scott Adams.

Say, if you run across any books or even TV shows that I may have missed, let me know. I do have a section in my guide to books you should read on the most outstanding humor books I've read—like by Stephen Potter, Benchley, Thurber, and H. Allen Smith. I'd love to find new additions—how about it?

DVD

I hope it's no news flash to you that we're going to be seeing an increasing flurry of digital video discs. They're the same size as CDs, but they hold over nine times more data, which has made it possible to put a whole movie on a single disc. They crammed the additional data on the discs by making the pits nine different depths instead of just one. With movies this will enable them to add different endings, sound tracks in several languages, comments on the production, and other trivia.

The discs will be lower-priced than video tape, so as players come down in price we may see the movie renting public buying the new players. The pictures will be much better than on tape, and you don't have to fast-forward or rewind to find something. No, you can't yet record your own.

Judging from the ubiquity of video rental stores, I'm one of the few people who doesn't rent movies. Or buy them, either. I go to the movies every week or so, and catch a few of those I miss in PrimeStar. I haven't missed very many good movies, but I sure have watched a bunch of turkeys.

I can't think of any good reason for me to get a DVD player yet. Heck, Sherry bought a video disc player and we've never used it. I do keep my VCRs busy. I rarely watch any shows live, preferring to time-shift them for my convenience and so I can skip through the commercials.

Pesticides

The marvels of modern chemistry have made it so bugs won't attack sick crops. If you've read much about plants you know that insects tend not to attack healthy plants. But with the minerals in most of the world's soil completely exhausted, and crop growth only possible through the use of chemical fertilizers, farmers have to spray the heck out of their crops to keep insect damage under control. And you, oh trusting consumer, are buying these well-sprayed chemically-grown foods and raising the devil with your body when you eat them.

A good washing will generally get rid

Continued on page 80

Ham Radio Fun

Communications Simplified, Part 21

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

Everyone knows that you need a modem to send digital data through a telephone line. That piece of conventional wisdom turns out not to be entirely true. You can send a lot of stuff through a telephone line, without a modem—even high-speed digital data or video, if you do it right. We will discuss modems in a moment, but first the big picture.

POTS

POTS is the abbreviation for the *Plain Old Telephone System*—also sometimes called PSTN for *Public Switched Telephone Network*. **Fig. 1** shows a very simplified diagram of the overall system.

Your home telephone has a microphone (also called a *transmitter* in telephone lingo) and an earphone (called a *receiver*), which convert between sound and electrical signals. These connect to the telephone line through a *hybrid*.

More details on the hybrid later; for now, we need only say that the hybrid interfaces the two one-way or *simplex* connections (to the earphone, and from the microphone) to the two-way or *duplex* telephone line which leads to the telephone company's *central office*.

The telephone line, called the *local loop*, is a *twisted pair*—a balanced line consisting of two thin conductors (typically 24-gauge) which are twisted together to reduce interference—which connects between your telephone and the central office. It is important to remember that this line carries voice simultaneously in both directions.

At the CO, another hybrid splits the two-wire two-way local loop back into two one-directional connections. The outgoing signal is converted from analog to digital, and stays digital all the way until it gets to the central office at the far end. The boxes labeled "Digital channel" in **Fig. 1** could be made up of copper cables, optical fibers, microwave relays, or even satellite links.

Because the conversion to and from digital form is done at a sampling rate of 8000 Hz, anti-aliasing filters in the system cut off all audio above roughly 3500 Hz. This is fine for audio, but doom for pure digital signals—it means that digital pulses, which tend to consist of square edges with plenty of harmonics, have no chance of getting through the system without some help.

The modem

With the above background, you can now understand the function of the modem. The modem (whose two main components are a *mod*ulator and a *dem*odulator—that is where it gets its name) takes the digital data and disguises it to look like sound. In simple terms, it takes the digital data and modulates it onto an audio carrier at one end of the connection, and then demodulates it at the other end back into digital data. Temporarily converting it into audio keeps the telephone circuits happy.

It's useful to trace the development of modems to understand the techniques they use.

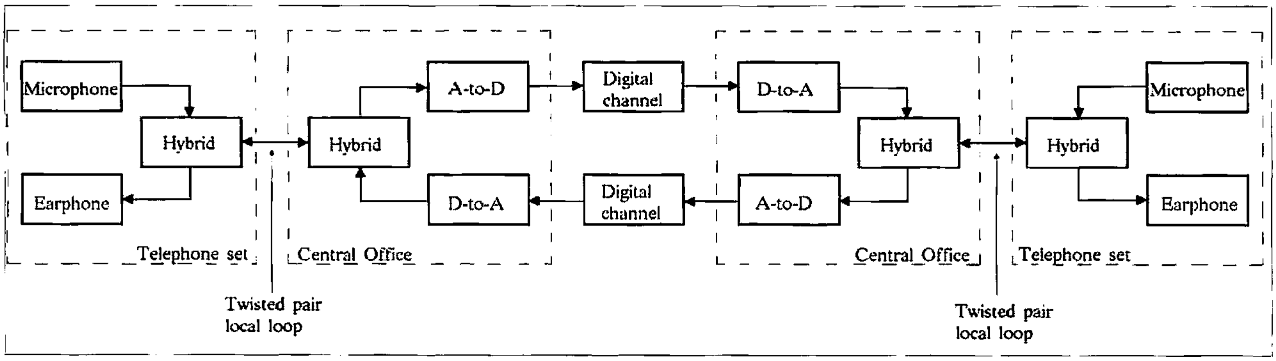


Fig. 1. Signal path through the POTS network.

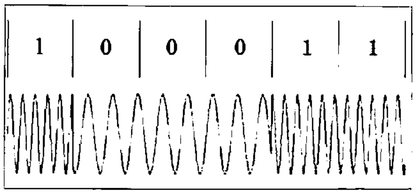


Fig. 2. Frequency-shift keying (FSK).

The Bell 103 modem

Up until the mid-1970s, only telephone companies ("telcos") were allowed to connect equipment to phone lines. Early modems were therefore identified by the model numbers assigned to them by the telcos, usually part of the Bell System. The model 103 was the first commonly-available modem, useful for carrying data up to 300 bits per second (bps). It modulated the digital data onto an FM carrier, with a different carrier frequency used in each direction.

Because the digital data only has two values—a 0 or a 1—the FM carrier, rather than continuously deviating back and forth over some range, jumps back and forth rapidly between two frequencies—a high frequency (which represents the digit 1) and a low frequency (which represents a 0). Since the carrier jumps (or "shifts") back and forth between them, the modulation method is called FSK or *frequency-shift keying* rather than just FM. You can consider it as plain FM with a square-wave modulation; since the square-wave modulation has a fundamental and many harmonics, there are multiple sidebands on both sides of the carrier. But the higher harmonics of a square wave are progressively smaller, so the sidebands farther from the carrier frequency drop off rapidly.

Fig. 2 illustrates what FSK looks like—a few cycles of a high frequency for a 1, and a few cycles of a low frequency for a 0. (The figure also shows a problem that has to be avoided in normal use. Note how the signal has sharp edges between adjacent bits; these edges cause clicks and interference. In an actual FSK signal, the signal has to maintain *phase continuity*; that is, it has to smoothly and continuously blend from one frequency into the other.)

The 103 modem was *full duplex*, meaning that it allowed signals to go in both directions at the same time. (A mini-detour at this point: *Half-duplex* transmission also goes in both directions, but only one direction at any one time—the two modems in the connection must take turns sending to each other. *Simplex*, on the other hand, allows transmission in only one direction.)

To avoid interference, full duplex in the 103 modem required two separate carrier frequencies, one in each direction. The modem which placed the call (called the *originate* modem) sent out a carrier frequency of 1170 Hz with 100 Hz deviation up and down; the carrier frequency thus shifted back and forth between 1270 Hz (1170 plus 100) for a 1 and 1070 (1170 minus 100) for a 0. (Note that, since only the digits 0 and 1 are possible in the digital data, only the frequencies of 1070 and 1270 Hz are allowed for the carrier. In other words, the carrier frequency never actually became the 1170 Hz center frequency.) The *answer* modem at the other end used the same 100 Hz deviation, but sent out a center frequency of 2125 Hz; its output was therefore 2225 Hz for a 1 and 2025 Hz for a zero. **Fig. 3** thus shows an originate modem—1070 and 1270 Hz are sent out, while 2025 and 2225 Hz are received.

The sidebands depend on the actual digital data being sent, but typically extend about 600-800 Hz on each side of the carrier. The originate modem's signal therefore occupies the range from about 300 to about 1800 Hz, while the answer modem's sidebands range between about 1500 to about 3000 Hz. You'll note that the sidebands interfere with each other in the middle range of 1500-1800 Hz between the two carriers. Fortunately, the sidebands farther from the carrier drop off rapidly with square-wave modulation, which helps to reduce the interference somewhat. Still, the signal leaving each modem does interfere somewhat with the incoming signal.

Unfortunately, there is another effect which also comes into play. Since each carrier may have to travel through a lot of circuitry on its way from one modem to the other, the outgoing signal from the modem is much stronger than the incoming signal, typically by 20 dB or more. The outgoing signal therefore interferes with the incoming signal, which the modem's demodulator is trying to receive. The effect is somewhat like trying to hear someone far away while someone else is yelling into your ear. The fact that the incoming and outgoing sidebands overlap to some extent makes things even worse.

As shown in **Fig. 3**, the modem has two circuits which try to solve the problem—a filter, and a *duplexer* (which is just another name for the hybrid). The filter passes mainly the frequencies to be received, and tries to eliminate the outgoing signal (as well as other noise picked up on the phone line) from getting into the demodulator. But because the outgoing and incoming sidebands interfere in the middle frequencies, the filter cannot completely eliminate the outgoing signal without also removing some of the incoming signal.

That's where the duplexer/hybrid comes in. We have already mentioned that a hybrid acts as an interface between one two-way circuit (which typically requires two wires) and two one-way circuits (which typically have two wires each, so together they need four wires). The name duplexer comes from its ability to combine two simplex signals into one duplex signal.

But it does more than that. It also acts as a one-way valve, letting the outgoing

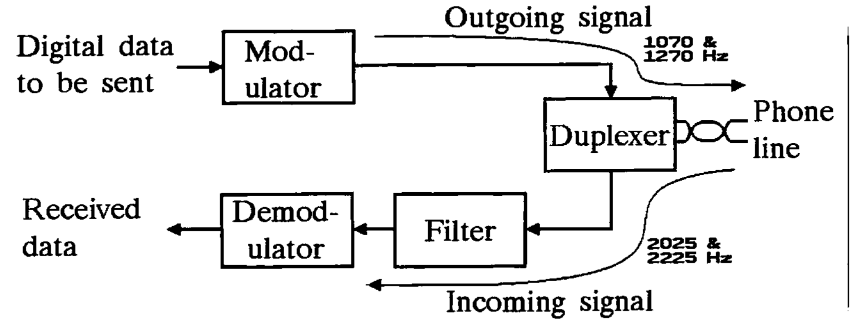


Fig. 3. Bell 103 modem block diagram.

signal go from the modulator to the phone line, letting the incoming signal go from the phone line to the filter and demodulator, but preventing the outgoing modulated signal from taking the shortcut down to the filter.

Telephone company people call their duplexer a hybrid, primarily because their circuit uses a combination of a transformer, capacitor, and resistor (and a few other components). **Fig. 4a** shows the telephone hybrid used in many older telephones. Although **Fig. 4a** shows two transformers, actually there is only one transformer because all five of the windings are wound on one common core. An incoming signal from the telephone line flows through the four upper windings (which all act as one big primary), and then through the transformer to the earphone. You thus hear the person at the other end of the line.

When you speak, however, the outgoing signal from the microphone comes in at the center of the top four windings, and splits in half—roughly half of the microphone audio signal goes right to the phone line, while the other half goes left to resistor R and capacitor C. Because the currents go in opposite directions, they cancel in the transformer, and very little of the signal gets sent to the earphone. You hear your own voice, but not very loud.

In order for the microphone current to split in half, with equal parts going right and left, the impedance on the right and the impedance on the left must be equal. Resistor R and capacitor C are thus chosen so that their series impedance is approximately equal to the impedance of the telephone line; they are sometimes called a *balancing network*. If R and C were chosen exactly right, the mike currents going right and left would exactly balance each other, and you would hear none of your voice in the earphone at all. This is hard to achieve, because every telephone line is slightly different and requires slightly different values of R and C. In any case, complete canceling of your voice from your earphone is not desired—most people like to hear a bit of their own voice to convince themselves that the telephone is working! So, in an actual telephone, R and C are intentionally slightly off to produce a slight amount of what is called *sidetone*—the feedthrough of the mike signal into the earphone.

Fig. 4b shows a more solid-state version of the hybrid (and there are other versions, too). As before, resistor R and capacitor C are a balancing network whose impedance should be equal to the phone line. The outgoing signal from the modulator, coming in at the left, is split in two. Part of it goes through resistor R_a to the balancing network, while the other part goes through resistor R_b (and a transformer) to the phone line. Resistors R_a and R_b are equal: if the impedance of the balancing network is the same as the impedance of the telephone line (as seen through the transformer), the voltages at the + and - inputs to the op amp will be equal. An op amp amplifies the *difference* between its two inputs, but there is no difference between them and so the amplifier amplifies nothing. So none (or, at least, very little) of the outgoing signal gets from the modulator into the demodulator.

The incoming signal from the phone line, on the other hand, goes directly through the transformer to the + input of the op amp, where it is amplified and sent to the filter and then the demodulator.

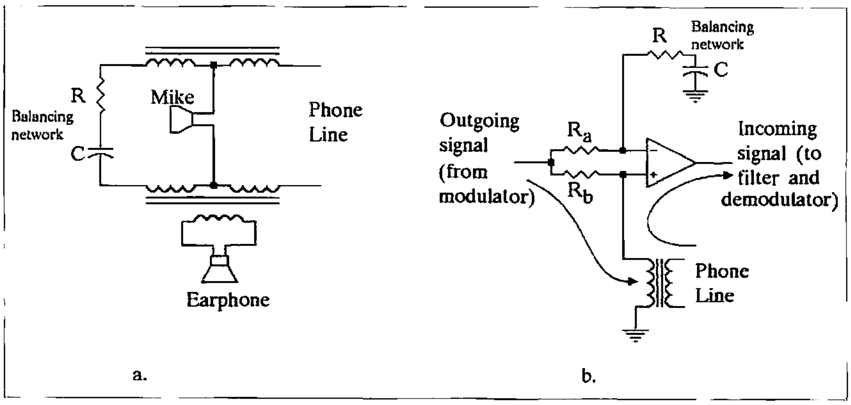


Fig. 4. The hybrid/duplexer circuit.

Because you want sidetone in a normal phone, the hybrid circuit inside the telephone is intentionally not completely balanced; that is, the RC balancing circuit is intentionally slightly misadjusted. In a modem, on the other hand, the situation is reversed—you must eliminate the sidetone as much as possible to avoid confusing the demodulator. Still, it is not possible to manufacture a modem with the precisely exact values of R and C for every possible situation.

Returning to the 103 modem, it is now clear that some of the outgoing signal from the modulator will get back into the demodulator and cause interference. Combined with any external noise and interference coming in from the telephone line, this makes it harder for the demodulator to correctly identify the incoming frequency.

If you look at **Fig. 2**, you will note that the difference between the high frequency and the low frequency in that FSK signal is fairly obvious. But this figure exaggerates the difference because it uses a 2-to-1 difference in frequencies. The actual difference between the two frequencies in a 103 modem was less than 20% for the low tone, and less than 10% for the high tone. If **Fig. 2** showed such a small difference, you would have a hard time telling the difference by eye. The demodulator has the same problem; it therefore needs several cycles of a tone before it can reliably tell whether it has a 1 or a 0, and this effect limits the bit-per-second rate that the modem can handle. As a rough rule, these modems needed about two or three milliseconds of a signal before they could correctly identify the signal; this therefore set the shortest bit-time at 2 or 3 ms. In this way, we can see that the fastest modem speed was somewhere in the range of 333 to 500 bps. Since the two nearest common bps rates used at that time were 300 or 600 bps, these modems could clearly work at 300 bps or slower, but not at 600 bps.

One way to speed up operation is to make the difference between the low and high frequencies greater, so that fewer cycles of a signal would be needed to tell them apart. This led to the Bell 202 modem, which used 500 Hz deviation on a 1700 Hz carrier; the FSK therefore shifted the frequency to 1200 Hz (for a 1) and 2200 Hz (for a 0). This speeded

up operation to 1200 bps, but used up the full bandwidth of the phone line. As a result, the modem could only be used in one direction at a time; it was therefore a half-duplex device.

DPSK modems

Once it became legal to connect your own modem to a telephone line, modem design changed from a Bell monopoly to a free-for-all, with many companies using incompatible methods to increase speeds. Gradually, a set of standards was developed by the CCITT (The Consultative Committee for International Telephony and Telegraphy, which is now called the International Telecommunications Union—Telecommunications Sector or ITU—T.) The progression of modem speeds is shown in the listing of standards (the letters bis and ter refer to the second and third revision of a standard):

V.21: 300 bps
V.22: 1200 bps
V.22bis: 2400 bps
V.32: 9600 bps
V.32bis: 14,400 bps
V.32ter: 19,200 bps
V.34: 28,800 bps
V.34Q: 33,600 bps

Modems up to 1200 bps used the older, simpler techniques we discussed in the previous section. Significant speed increases came later, with the development of differential phase-shift keying or DPSK.

Instead of changing the frequency, DPSK modems change the phase of the carrier. **Fig. 5** shows a simple example. Suppose we agree that

0 is a 0° phase shift, and
1 is a 180° phase shift.

We start off with a carrier, and for each bit change the phase (from the previous bit) by 0° for a zero, and 180° for a one. This will give us the waveform in **Fig. 5**. Since a 0° phase change is no change at all, we only see the phase change (by 180°) at the beginning of each 1. It's clear what PSK means in this context; the D in DPSK means that the phase changes not from some fixed reference, but from the previous bit; it is the difference between consecutive bits.

Since this system has two possible phase changes, it is called a DPSK-2 system.

Let's now consider a slightly more complex example, called DPSK-4 because there are four possible angles, defined as follows:

00 = 270°
01 = 180°
10 = 90°
11 = 0°

To use this, we will divide our data (100011 in the prior examples) into groups of two bits called *dibits*—10, 00, and 11—and then send each dibit on its own portion of the signal; that portion will be called a *symbol*. We encode each group of two bits onto its symbol by changing the phase angle of that symbol according to the above table. For these six bits we have:

10 = 90°, which means go forward 90°, or skip forward 1/4 of a cycle;

00 = 270° means jump ahead 45°. This is equivalent to -90°, which tells us to go back 90°;

11 = 0° means no change in phase.

The result is the signal in **Fig. 6**, where we have shown the -90° phase change at the beginning of the 00 dibit, and also noted that the phase does not change for the 11 dibit. (If you look carefully, you can also see the +90° phase change at the beginning of the 10 symbol, as well as another change at the far right, after the 11 dibit's symbol.)

Figs. 5 and **6** bring up an important concept. Suppose the bandwidth of a circuit is such that we can only change the signal's phase 600 times per second; i.e., we can only send 600 symbols per second. If we used the simple scheme of **Fig. 5**, then each symbol would only carry 1 bit, and therefore we would also be limited to 600 bits per second. But using the scheme of **Fig. 6** lets us pack *two* bits into each symbol; we can therefore send 1200 bits per second, instead of 600. We have thus doubled the amount of data that can be sent through the phone line in each second.

Let us now define a very misunderstood term: *Baud rate*. The baud rate is the number of symbols (or signal changes) per second. It is misunderstood because many people think that "baud rate" means "bit-per-second rate," which is true only in very simple cases.

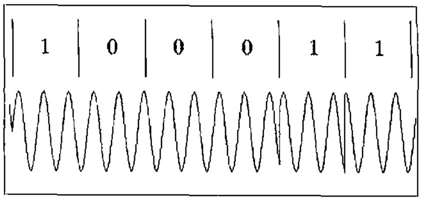


Fig. 5. DPSK-2 with two phase angles.

Look at either **Fig. 2** or **Fig. 5**. In both of these cases, each symbol carries at one bit. In this very simple case, the number of symbols per second is also equal to the number of bits per second. So the baud rate is equal to the bps rate. But look at **Fig. 6**—here each symbol carries two bits. Hence the bit-per-second or bps rate is actually *twice* the baud rate!

Because of the limited bandwidth of the common telephone line, modems are limited to about 3000 symbols per second or 3000 baud. What is commonly advertised as, for example, a "9600 baud modem" actually generates a 2400-baud signal which crams 4 bits on each symbol to give an effective rate of 9600 bps. The same idea holds for faster modems.

The term baud rate is misused so often that it has become common to refer to the bps rate as the baud rate. But you should remember the difference because, every now and then, some stickler for accuracy (like a teacher or college professor) will try to trip you up on the difference.

The information we have tabulated so far as

00 = 270°
01 = 180°
10 = 90°
11 = 0°

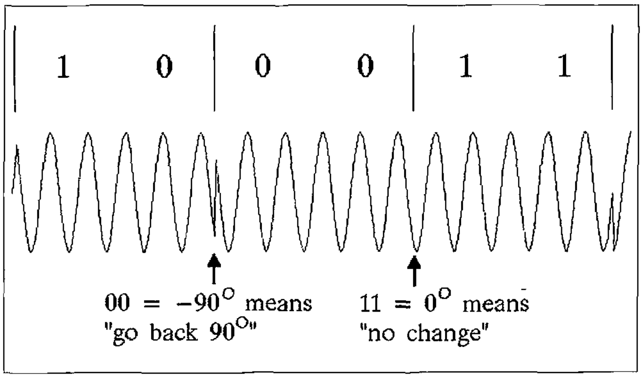


Fig. 6. DPSK-4 with four phase angles.

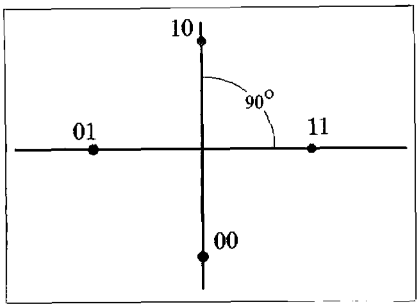


Fig. 7. A DPSK-4 constellation diagram.

can be shown in a slightly different form called a *constellation diagram*, **Fig. 7**. Imagine that each of the four different angles is a vector whose angle indicates the phase angle, and whose length represents the amplitude of the corresponding symbol (all the vectors in this example would be the same length, because the amplitude of the DPSK signal is constant—so far). To reduce the clutter, though, we simply put a dot where the end of the vector should be, rather than drawing a full arrow. For example, the dot at the top represents a vector at 90° (angles are measured from the right axis, just as in normal math). Each dot is labeled with its corresponding bit pattern, so the one at 90° is labeled 10. The constellation diagram is merely a more compact way of listing the same information as the previous table.

The reason for using constellation diagrams is that they let us show how faster modems really work. For example, a fairly simple 9600 "baud" modem (which is really a 2400-baud modem, working at 9600 bps because each symbol carries four bits) has the constellation diagram shown in **Fig. 8**.

QAM

Quadrature Amplitude Modulation or QAM is the basis of all modern high-speed modems. **Fig. 8** is a very simple example of QAM, which is a combination of differential phase shift keying (DPSK) and amplitude shift keying (ASK).

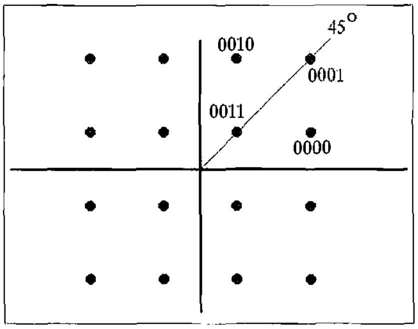


Fig. 8. 9600-bps DPSK-16 modem.

As we see in the figure, the constellation chart of this 9600-baud modem has sixteen dots. Each dot carries four bits (since 2^4 is 16), so 2400 symbols per second—2400 baud—will carry 4 x 2400, or 9600 bps.

All together, the sixteen dots appear at 12 different phase angles. But note also that the dots are not all equal distances from the center of the chart. Remember that each dot simply represents the tip of a vector; the direction of the vector shows the phase angle of the symbol, while its length shows its amplitude. For example, the dots that carry 0011 and 0001 are both at an angle of 45°, but 0011 has a small amplitude, while 0001 has a large amplitude.

This method therefore combines phase-shift keying and amplitude-shift keying to provide the 16 different symbols needed to permit a fairly high bit-per-second rate, while still keeping the baud rate—the actual number of different symbols in each second—within limits.

But there is a price to pay—with two different phase shifts as in **Fig. 5**, the difference between any two successive symbols is either 0 or 180 degrees, and it is fairly easy to tell the difference between them. With the 12 different phases of **Fig. 8**, and three different amplitudes, there is only about a 30-degree difference between the various phases. Add some noise, and possibly even phase differences introduced by the telephone line, and you can see that a modem's demodulator can easily make mistakes.

Now imagine that we want to extend this idea to faster modems. For example, suppose that we just double the speed to 19,200 bps. Still being limited to 2400 baud, we must pack 6 bits on each symbol. Now there must be 2^6, or 64 different dots in the constellation chart. If we use three different amplitudes, there will be 32 different phase angles. You can see that this would greatly increase the modem's error rate, probably making it unusable. So something else has to be done.

DETOUR

Before continuing, just a quick detour to explain the word quadrature in quadrature amplitude modulation.

In math, quadrature means "at right angles." But the angles in DPSK are not 90°, so why is it called quadrature?

In math, a sine wave and a cosine wave look the same, but they are shifted 90° apart; they really are in quadrature. If you add a sine wave to a cosine wave of the same frequency, you get a new signal which looks just like a sine wave, but is offset by some new phase angle. The modem's modulator produces the 12 different phase angles in **Fig. 8** by adding various amounts of the quadrature sine and cosine signals together.

END OF DETOUR

Modern modems

So how do modern 28k or 33k modems achieve their remarkable speed and performance? By using a number of tricks. Some of these involve fairly complex math, so we will only give a brief qualitative description, without any of the mathematical detail.

Negotiation and line probing

When one modem calls another, the answering modem sends back a tone to tell the caller that it is there. The two modems now start to negotiate with each other to decide what speed they will use, what kind of modulation to use, what carrier frequency and amplitude to use, and so on. If the connection is very bad, the modems will agree on a *fallback speed*, a slower speed which allows error-free communications even with a bad circuit. In fact, 28.8k bps and faster modems can even fall back to different speeds in each direction.

Echo suppression

Remember that the old FSK modems used different frequencies in each direction; this meant that only half the bandwidth was usable in each direction. To achieve high speeds, modern modems need the full 300-3500 Hz bandwidth of the line each way. Each modem therefore has to make sure that the outgoing and incoming signals are kept completely apart—none of the locally-generated signal should enter the local demodulator and cause errors.

The modulator therefore sends out a short test pulse, and the demodulator listens for it. Ideally, none of the test pulse should get through the duplexer, and none should be echoed back from the

phone line, so the demodulator should hear nothing. In reality, though, the demodulator will hear a small signal, probably with some delay caused by travel through the phone system. The modem then computes an "equal, but opposite" signal which, when added to the signal heard by the demodulator, will cancel it out. In all further communication, the modem will automatically use this to compute an echo cancellation signal, sent to the demodulator to cancel out any echo or signal slipping the wrong way through the duplexer.

Scrambling

Even though the digital data being sent by the two modems may be asynchronous, the connection between the two modems is actually synchronous. This improves the speed somewhat, because synchronous connections do not require constant start and stop bits; they also have better error detection in the form of a CRC character.

But synchronous communications requires that the sending and receiving modems remain synchronized with each other. That is, each modem must have a clock oscillator, and the two clocks must run at exactly the same frequency. Rather than send a clock signal through the phone line (which would take up bandwidth and slow down the data), the receiving modem has to synchronize its clock from the data itself.

But some combinations of data may prevent that. For instance, look at the DPSK-4 scheme in **Fig. 7**. If the data consisted of a long string of ones, the signal would consist of a long carrier with a constant 0° phase shift. The receiving modem would have a difficult time telling where one symbol ends and another begins.

To avoid this problem, modern modems scramble the incoming data in a known way so as to avoid these troublesome combinations. (Needless to say, the receiving modem must then also unscramble the bits.)

Trellis coding

Even after all the previous tricks, the receiving modem is still likely to make errors when the constellation contains many points. Hence some sort of error correction is needed. Since errors are fairly likely, a backward error correction (where the receiver asks for a retransmission when it detects an error) is not desirable as a primary method—too much time would be wasted. So a form of forward error correction called trellis coding is used. To keep things as simple as possible (a difficult task!) let's confine ourselves to a 9600-bps modem.

Fig. 8 showed the 16-dot constellation of a simple 9600-bps modem. Actually, most modern 9600-bps modems use trellis coding with the 32-dot constellation of **Fig. 9**. When you look at this, you note that the dots are even closer together than those of **Fig. 8**; hence you probably suspect that there must be even more errors than before. This would be true—except that there are two more tricks up the designers' sleeves that we haven't yet covered: trellis modulation at the sending modem, and Viterbi detection at the receiving modem. These two techniques work together to greatly reduce errors.

First, we note that the telephone line can carry 2400 baud (symbols per second), and this is a 9600-bps modem. Hence we only need to put four bits on any one symbol, and therefore only need 2^4 or 16 different symbols; having 32 is overkill.

What the sending modem does, however, is to add a fifth error-correction bit to every group of four bits (in a sort of scrambling operation that mixes in some of the previous data, and actually changes two of the four desired bits as well); hence each symbol actually encodes five bits, although only four of these are actual data; this explains the 2^5 dots. The resulting five bits now depend not just on the current bits, but also on the data that was sent earlier.

So let's assume that you are sitting inside the sending modem, monitoring what is going on. You know that at some particular instant, the modem just output the particular symbol that corresponds to dot A in **Fig. 9**. The modem now gets the next group of four bits, and its trellis coding circuit computes a new five-bit code from it. But the coding circuit must follow very specific rules; given a particular set of four bits (and a particular history of past data) it must generate a very specific five-bit output code. In other words, since there are only 16 possible combinations of new data, there can only be 16 possible numbers it generates. In still other words, although five bits can make up 32 different numbers, only 16 of those 32 can actually come out of the coder; the other 16 are illegal at this instant (they could be generated other times, however).

What this means is this: there are 32 possible symbols in **Fig. 9**, but if you have just output symbol A, 16 of those 32 symbols are illegal for the next symbol. For instance, symbols B and C might be legal, but D and E might not.

So what does all this mean? It means that, although the dots in **Fig. 9** are much closer than those of **Fig. 8**, if you cross out all those that are illegal at any particular instant, you find that the remaining ones are roughly the same distance apart as those in **Fig. 8**. In other words, the presence of 32 dots is no worse than the 16 dots of **Fig. 8**.

So far, it looks like **Fig. 9** is no worse than **Fig. 8**, but no better either. But that changes with the next trick:

Viterbi detection

Let's suppose that the sending modem sent out a batch of data and ended up on symbol A (all of which the receiving modem received correctly). It next sends out symbols B and E in that order, but the receiving modem makes an error and thinks the sending modem sent out D and E (see **Fig. 9**).

Since all the previous data was received correctly, the receiving modem knows which 16 out of the 32 symbols would have been legal after A. It doesn't know which one was actually sent, but it does know that it couldn't have been D, because D is not legal after A (at this particular time).

Think of the correct sequence A-B-E as being a road through a maze—the maze is the constellation diagram—

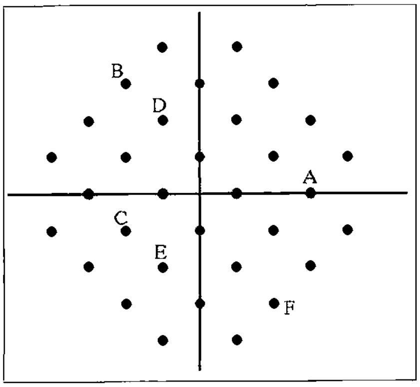


Fig. 9. Trellis constellation for a 9600-bps modem.

where only certain dots in the diagram have roads connecting them at any particular instant. The receiving modem now says to itself: I've been told that the sender route was A-D-E, but there is no road there. What is the closest actual road that starts at A, passes close to D, and ends close to E?

The receiving modem knows all the rules of the game; it can determine which roads go where and when. So it makes a list of all legal roads that start at A, pass close to D, and end close to E. That list might include roads A-B-E, as well as A-F-E and A-D-C. It then goes through a fairly simple computation to determine which of these is closest to the A-D-E route that it thinks the other modem sent, and comes up with A-B-E as being the most likely.

This process sounds pretty chancy (and it is—since it is based on the rules of probability), but actually works quite well. Think of probability this way: Suppose you take a quick measurement of, say, the length of a room. If you're fairly sloppy about it, your measurement may be wrong by several inches, but if you measure the room several times and average your readings, the average will generally be fairly close to the actual value because your various errors will tend to cancel themselves out.

The trellis code/Viterbi decoding scheme relies on the same principle. Modern modems generally keep track of up to four or five symbols in a row, and use the closest legal path that matches the last four or five received symbols. Since a path involving four or five consecutive symbols is fairly complex, the number of legal paths that will lie close is fairly small; hence the Viterbi decoder can pick out the correct path with a fairly good chance of success. Just in case of error, however, most modern modems apply error correction (and possibly data compression) to the received data before they pass it on to the communications program.

28,800 bps modems ...

... use similar schemes, but with much greater complexity. For example, a 28,800 bps V.34 modem uses an actual line baud rate of 3200 symbols per second (just about the absolute maximum that the phone line can handle). To send 28,800 bps, it needs to pack 28,800/3200 or 9 bits into every symbol. This would give it a minimum of 2^9 or 512 dots on its constellation chart. If we drew this chart, the dots would be so close together that they would be almost impossible to tell apart. In reality, the V.34 modem uses trellis coding and Viterbi detection with 960 dots.

56k modems

Modem speeds of 28k or 33k bps seem to be about the fastest that the normal voice-oriented POTS telephone network can handle with today's technology. Faster speeds require a little help from the telephone company.

Fig. 1 showed how the POTS network handles a voice call with a microphone and earphone at each end, connected through hybrids to the local loop, and then using a pair of analog-to-digital and digital-to-analog converters at each end of the phone network itself. When a pair of 33,600 bps (or slower) modems talk to each other, the configuration is almost the same, except that a modulator replaces the microphone, and a demodulator replaces the earphone. As a result, digital data is first converted to audio; then an A-to-D converter converts it to digital for transmission through the network (which itself uses 64k data transmission); then a D-to-A converter converts it back into audio, and finally a demodulator converts it back to digital. A rather roundabout process, which results in less than optimum speed.

56k modems, such as US Robotics' (now 3Com) x2 modems, are slightly different. They are not really designed to work in pairs; in fact, if two 56k modems call each other, they will only work at 28,800 bps, just like any other V.34 modem. Instead, they are designed to allow an Internet customer to talk to his Internet service provider (ISP). The 56k modem forms an asymmetric system—fast one way ("downstream," from the ISP to you), slower the other ("upstream," from you to the ISP). This is ideal for accessing the Web.

In the upstream direction, the 56k modem works at normal 28,800 bps speed, using trellis/Viterbi coding, just as we described earlier. The difference is in the downstream direction.

In order to provide 56k service, the ISP must install a digital line from their computer back to the telephone company's central office. Rather than convert the digital downstream data into audio, the ISP sends it down as pure digital data. At the central office, the data bypasses the line card's A-to-D conversion; it stays digital all the way back to *your* central office, at which point it is converted to analog for the last portion of its trip, down to your modem.

The idea is that the initial A-to-D conversion at the ISP's central office creates the most problems; so the ISP bypasses that step by sending digital data directly into the network.

All the data arrives correctly at the central office serving your local loop; at this point, the bits are converted to discrete steps which (hopefully) will make it through your local loop, and be reconstructed by your modem. Unfortunately, there is a minor problem here.

In "Part 20," we said that telephone companies use µ-law compression to provide 13-bit accuracy with just 8-bit data. This varies the step size, to give small audio signals better resolution. Unfortunately, this converts some incoming digital data into voltages so small that they are corrupted by noise. To avoid this problem, the ISP sends 7-bit data, rather than 8-bit data. This results in 128 voltage steps rather than 256, eliminating the 128 smallest voltage levels—the ones that cause the most problem with noise. Alas, this reduces the data rate from 64k bps to 56k bps (actually, because of limits on maximum allowed signal levels, the actual speeds are closer to 53k bps).

Oscillator Circuits

Part two in a series of three.

Hugh Wells W6WTU
1411 18th St.
Manhattan Beach CA 90266

As you may recall, last time we discussed the feedback and crystal control of an oscillator. This month, we'll look at some typical self-excited and crystal-controlled oscillator circuits.

Remember, a crystal operating in the resonant mode will exhibit a low impedance across its terminals and a zero degree phase shift, while an anti-resonant crystal will exhibit a high impedance across its terminals and a 180° phase shift. In this article, circuits #3, #6, #7, #10, and #12 have a resonance requirement for the crystal. The crystals in #1, #2, #5, and #9 are anti-resonant.

The design of a circuit will take advantage of the specific impedance and phase characteristic provided by the crystal. In the case of the self-excited oscillator, the coil and capacitor in the resonant circuit are connected to meet the oscillator design requirements in a manner similar to the crystal.

Circuit 1: A Pierce design using an anti-resonant crystal in the feedback path between the collector and base of a transistor. Excitation, or crystal drive, is adjusted by the value of the 390 pF base bypass capacitor. This value is kept as small as possible, but large enough to achieve reliable oscillator starting. The frequency operating range for this circuit is about 100 kHz to 18 MHz.

Circuit 2: Another Pierce design uses an FET and operates as described in Circuit 1 above. The excitation capacitor is variable and is used to control the excitation level and to "pull" the frequency of the oscillator for netting purposes.

Circuit 3: This common-base Colpitts design requires the base impedance to be low for oscillation to be sustained. A resonant crystal exhibiting a low impedance from base to ground will enable oscillation to occur only at the frequency of the crystal's overtone. Frequency netting may be accomplished by varying the value of either the 3.9 pF or 47 pF capacitors. The 3.9 pF capacitor provides the feedback and the 47 pF controls the excitation level. The operating frequency range is crystal-overtone dependent (3rd, 5th, and 7th) covering 12 MHz to 200 MHz.

Circuit 4: In this self-excited common-emitter Colpitts oscillator, the coil and capacitor control the operating frequency. The ratio of the capacitor values connected between base, emitter and ground establish the feedback and oscillator stability. The frequency band is typically between 3 MHz and 30 MHz. Temperature stability of the circuit is fair and is dependent upon the mechanical stability of the resonant circuit components.

Circuit 5: This circuit is a crystal-controlled version of Circuit 4. It uses an anti-resonant crystal; the frequency stability is as good as the crystal. The 39 pF capacitor value may be varied for frequency netting and the excitation level is controlled by the value of the 68 pF capacitor. The operating frequency range for this circuit is about 100 kHz to 18 MHz.

Circuit 6: This is the common-base Colpitts oscillator; the feedback is obtained from the collector and coupled back to the emitter through the resonant crystal. Oscillation occurs when the impedance of the series crystal is slightly lower than the tuned circuit. The crystal drive is determined by the ratio of the 470 pF to the 130 pF capacitors. Note the 6.8 µH inductor across the crystal: Its purpose is to provide a DC path for the isolated top terminal of the crystal. The operating frequency range is crystal-overtone dependent (3rd, 5th, and 7th) covering 12 MHz to 200 MHz.

Circuit 7: A Hartley circuit is as popular as a Colpitts for implementing an oscillator. The basic difference between the designs is in the method for obtaining feedback—Hartley uses a tapped inductor while Colpitts uses a capacitor divider. Circuits 6 and 7 are nearly identical, including the frequency range, with the exception of the feedback method.

Circuit 8: This is a classic common-collector Hartley oscillator, used in broadcast radios since the late 1930s.

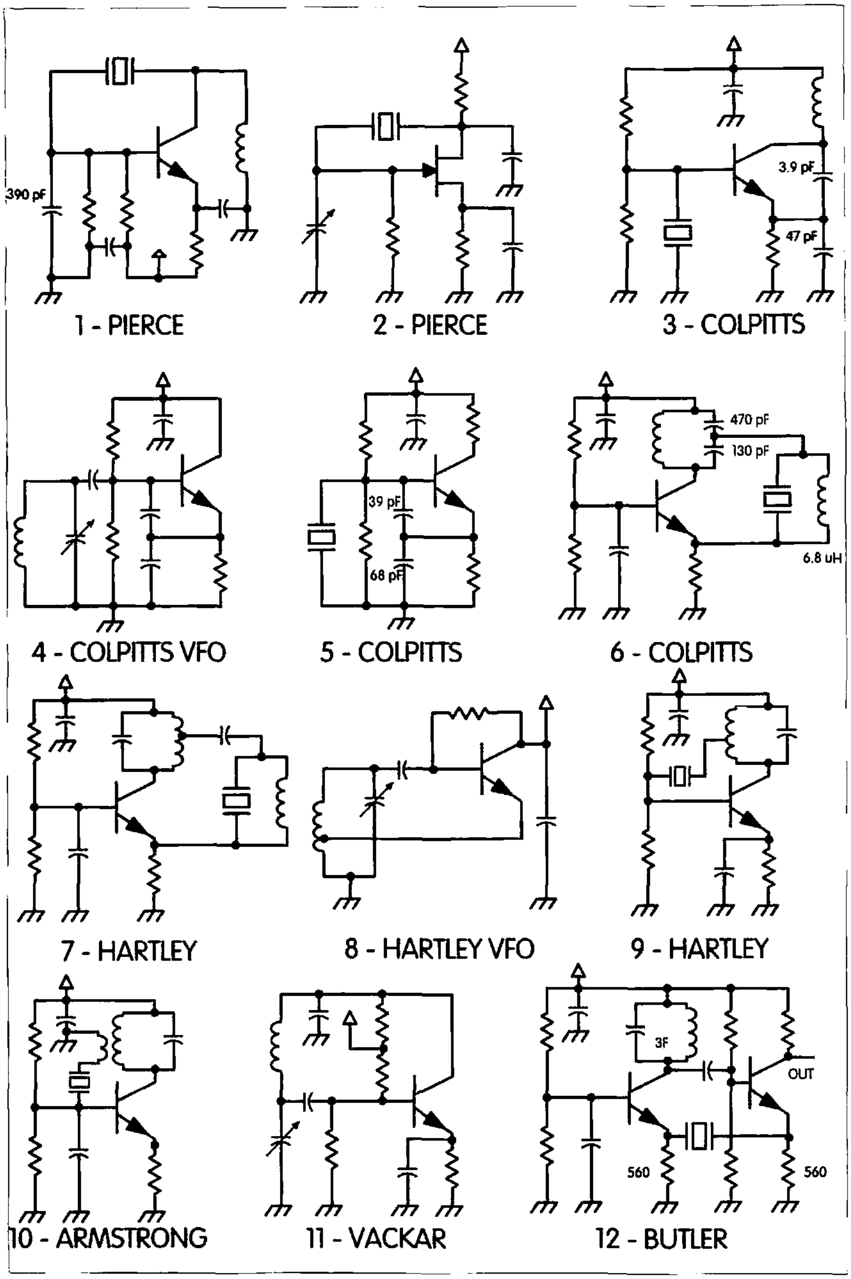


Fig. 1. Common—and not so common—transistorized oscillator circuits.

The frequency stability is fair and totally dependent upon temperature and the mechanical stability of the components. It is a reliable oscillator with a wide operating frequency range from a few kilohertz to over 1 GHz.

Circuit 9: This unusual common-emitter Hartley oscillator requires the overtone crystal to operate essentially in the anti-resonant mode. However, overtone crystals are designed to operate in the shear mode which results in a resonant (series) function, yet this oscillator operates as designed by obtaining the required 180-degree phase shift across the inductance value between the collector and the crystal.

Circuit 10: Armstrong was a strong contributor to oscillator development, in addition to other radio accomplishments during the 1920s, '30s, and '40s. Characteristically, an Armstrong oscillator uses a tickler winding near the resonant circuit to obtain feedback for sustaining oscillation. In this circuit, the feedback will pass through the low impedance crystal when the operating frequency matches the resonant mode frequency of the crystal. The resonant circuit is tuned to match the overtone frequency of the crystal and can operate in the frequency range 12 MHz to 200 MHz.

Circuit 11: The Vackar oscillator is a rare design. It was developed after the advent of the transistor. This circuit takes advantage of a series-resonant circuit which has a low impedance to ground at each end and a high impedance in the middle. This high impedance point drives the base of the transistor. Note that the collector and emitter circuits are at a very low impedance to ground. Therefore, the transistor can only provide a current drive to the resonant circuit, which results in very good thermal isolation and frequency stability due to a non-dependency on transistor gain.

Circuit 12: The Butler oscillator was designed originally for use with vacuum tubes for the purpose of generating a high harmonic frequency output from a low- to medium-frequency crystal. Although the circuit shown will output the third harmonic of a resonant mode crystal (3rd, 5th, or 7th overtone), a tuned circuit originally existed in place of the 560 Ω resistor in the Butler design. The original output tuned circuit was tuned to the second harmonic of the "3F" circuit. The combination of the two tuned circuits provided a multiplier of six times the crystal frequency. The signal output amplitude was never quite as high as desired for a transmitter, but the circuit worked well when used for oscillator signal injection in a receiver, and was utilized as a stable, inexpensive local oscillator for VHF and UHF converters.

The circuits shown are only a few of the many oscillator designs developed over the years. However, those shown represent the basic design characteristics that have been the backbone of modern communications equipment. Recognizing an oscillator circuit by its designer's name enables an understanding of how the circuit functions and eases troubleshooting effort. Next time: the basics of frequency synthesizers.

The ABCs of HF Antennas

Beginning hams, take heart!

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

Antennas can be a very confusing and often frustrating subject to understand, particularly for the newly licensed radio amateur. Entire books—quite a few of them, in fact—have been written on the subject of antennas over the years. Much of what we call *antenna theory* is often very difficult to visualize, partly because of the way it has been traditionally presented, and partly because it's often somewhat foreign to our normal view of the ways things work. This sometimes makes it hard for those in our hobby who aren't engineers to acquire a clear view of what is an admittedly complex subject. What I'm hoping to do here is to summarize some of the more *practical* information that you'll *most* need to know to make decisions on which antenna configuration might work best for you, without your having to sift through all of the available volumes right away.

I'll try to keep the discussion centered on antennas used in the HF bands—those below 30 MHz—with only brief references made to their VHF and UHF counterparts as needed for comparison, because the end use of antennas above 30 MHz can be very different from those used in the bands below 30 MHz. VHF/UHF antennas normally presume primarily line-of-sight communications and antennas of relatively small size. As a result, VHF/UHF antennas are pretty well standardized and normally don't present the same degree of installation problems that HF antennas present, since they can normally be easily installed on the smallest of urban lots. HF antennas, by contrast, are generally intended for use under ionospheric skip conditions and their installation should keep that objective in mind. They can also become very large physically as the frequency of operation goes lower, especially down at 1.8 MHz (160 meters). This often makes installation of an HF antenna in an urban environment "a challenge of compromises" on the part of the average amateur. It's therefore probably less confusing to keep these two ranges of ham antennas distinctly separate. These reasons will become even more apparent as we progress.

A single best?

To begin, perhaps it's best to be honest and say that there is no single best HF antenna for everyone; that's one reason why there are so many variations, I suppose. Just as there is no best automobile for everyone, there are many models and style categories to choose from. And like an automobile, the antenna that's *best* for you will depend in large part upon your own finances, the overall size that you can reasonably accommodate and the end result that you realistically hope to achieve—like the choice of an automobile or of many other products.

The Utopian antenna

We've all looked for that Utopian antenna, one that will cover all frequencies of interest, perhaps provide us with some gain and present a favorable angle of radiation, under all conditions. Unfortunately, like Utopia, it's not been discovered yet! In fact, books like the *ARRL Antenna Book* are as thick as they are because of the wide variety of possible antennas, and various refinements to them, that our fellow hams have experimented with over the years. It's also a book well worth your reading time after your exposure to the basics.

Instead of searching for something that doesn't yet exist, let's take a look at what does, and how it might apply to your individual circumstances. That's the key factor—your particular, individual circumstances. Each of us has practical limitations—some more so than others—on how much antenna wire, aluminum element tubing or tower structure we can put up, and still keep peace within our own family and in the neighborhood in general. This may be the most important factor in your final decision.

The two basic types

If you boil it down, there are two basic HF antenna types, but there are numerous variations on these two types, the classic half-wave horizontal wire dipole

and the almost-as-classic ground-mounted, quarter-wave vertical, normally made of aluminum tubing. All others are ultimately based on these two design configurations. Also, try to keep this in mind: Any resonant antenna must be at least an electrical one-half-wavelength long, it can be longer, but not shorter. There are methods of making the physical length of an antenna shorter using coils, while maintaining the correct electrical length; these are often seen on both horizontal and vertical commercial amateur antenna designs. The minimum electrical one-half-wavelength requirement, however, must still be met. How is a quarter-wave vertical possible, then?

The horizontal dipole

The half-wave horizontal dipole, most often made simply of wire, is well-suited for the HF amateur bands below 30 MHz, producing a pattern that resembles the symbol for infinity when viewed from either of its ends (**Fig. 1**). It's the classical center-fed wire dipole antenna strung between two opposite supports, with 1/4-wavelength of wire on each side of a center insulator (**Fig. 2**). This type of antenna can be fed with coaxial cable at that center insulator—most often using a 1:1 balun—with a balanced feedpoint impedance of roughly 75 ohms. It can also be fed with open-wire transmission line—via a balanced output antenna matching unit—for operation over a number of non-resonant frequencies. Though not as efficient as when it's operating as a truly resonant antenna, this scheme works because the losses in the higher-impedance, open-wire transmission line are very low at these frequencies, whereas the losses in a low impedance coaxial cable would be excessive and perhaps even damaging to the radio or to the coaxial cable itself.

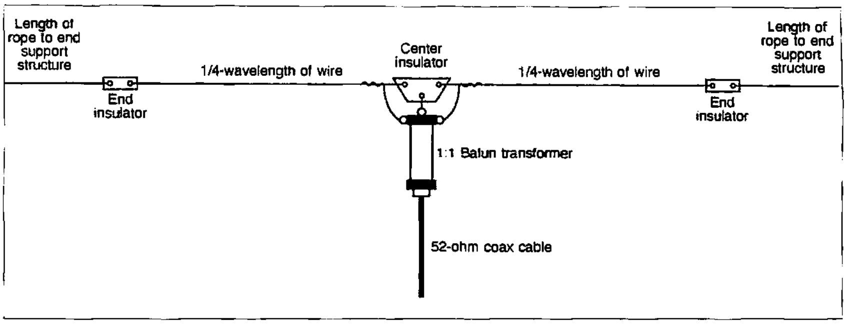


Fig. 2. Half-wave horizontal dipole, viewed from the side. Each wire element is 1/4-wavelength long, separated at the center by an insulator and connected to the coax cable via a 1:1 balun.

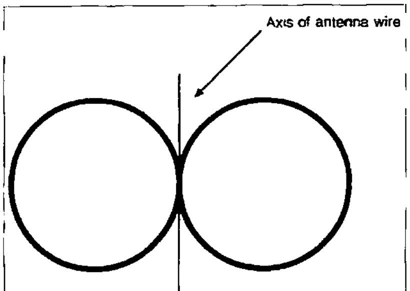


Fig. 1. Idealized radiation pattern of a half-wave horizontal dipole antenna, as viewed from directly above.

Horizontal half-wave wire antennas have been used ever since the very beginning of practical radio communications, and continue to be widely utilized by hams and some commercial shortwave installations to this day. Anything that's been proven by the test of time is worthy of your consideration. The biggest problem for most people seems to be in the ability to put one up high enough for the lowest of the HF frequencies. I'll get more into that a bit later. The other problem is in how to center-feed an antenna of this type and to have the transmission line drop down fairly close to where your equipment is located. That may be one reason why the backyard "radio shack" became popular in the early days of wireless communications, and still is in many parts of the world. The shack ended up where the transmission line drooped down from the dipole's center—that and the fact that the very early radio gear was definitely not "XYL-friendly" and was often best left out in the yard!

The quarter-wave vertical

The quarter-wave aluminum-tubing vertical antenna (**Fig. 3**) is the next most popular—and probably next oldest—form of transmitting and receiving antenna, and is also used by amateur radio operators and commercial broadcasters the world over. It will produce a basically circular radiation pattern when birds-eye-viewed from the very tip, looking downward (**Fig. 4**). It's typically fed at its base—very near the ground—with the shield of the coaxial cable going to the ground system directly, while the center conductor is connected to the above-ground vertical element. This represents a feedpoint impedance of about 35 ohms unbalanced, so it's also compatible with low-impedance coaxial cable transmission line.

You've probably noticed that the two feedpoint impedances that I've mentioned so far—75 ohms for a horizontal dipole and 35 ohms for a ground-mounted vertical—are slightly different from the 52-ohm coaxial cable that most hams traditionally use. These differences are too small to be of any real significance at these frequencies, representing a mismatch of about 1.5 to 1, and thus won't present a problem from a practical standpoint. They're also simply approximations of what a real-life antenna's feedpoint impedance might actually be; it can vary quite a bit. Additionally, it's generally considered best

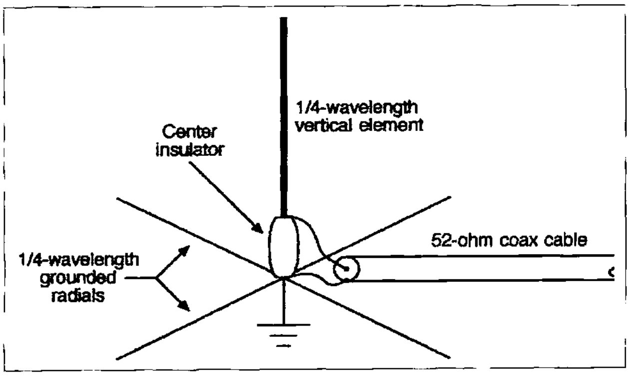


Fig. 3. Quarter-wave vertical, viewed from the side. Each radial, and the main vertical element, is 1/4-wavelength long. The center conductor of the coax is connected directly to the vertical element and the shield of the coax to ground.

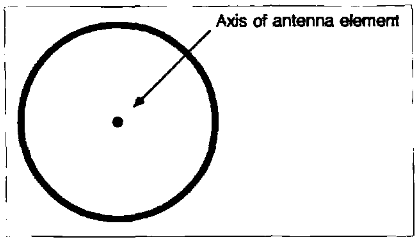


Fig. 4. Idealized radiation pattern of a 1/4-wave vertical, viewed from directly above.

practice to use a balun—balanced to unbalanced—RF transformer when feeding any naturally balanced antenna, such as a horizontal dipole (**Fig. 5**). It aids in keeping RF currents off the outside of the coaxial cable's shield when feeding such a balanced antenna. If the outside shield of the coaxial cable is allowed to become part of the radiating system—as it may be without a balun—power can be wasted in ineffective transmission line radiation. Also, any existing TVI and RFI conditions might be aggravated and interference pick-up from household appliances during receive might be increased. It's easy to tell if an antenna is balanced or not: if one side of the antenna's transmission line connection point is not grounded, then it's usually considered a balanced antenna.

The ground radial system

Getting back to our HF vertical antenna installation, the active metal-tubing portion of a vertical antenna must be insulated from the ground mounting support and all quarter-wave verticals must have an effective ground plane beneath them. The ground plane is actually the other *half* of the antenna. Remember when I said that all antennas must be at least a half-wavelength long? Well, in the case of what we call a quarter-wave vertical, the other quarter-wave—the other *half* of the antenna—is in the ground plane beneath it. It's also sometimes called the phantom or *image* antenna. So a quarter-wave vertical isn't really a quarter-wavelength long; the other quarter-wave is the ground plane, and a good ground plane is absolutely essential. That ground plane can be the roof of an automobile, the hull of a metal ship, the fuselage of an airplane, a wire radial system or very conductive earth ground itself. Generally speaking, unless the antenna is over a salt marsh, the earth itself is an unpredictable and too often a variable ground plane. This variable other half of the antenna can represent substantial losses when left unaddressed.

Metallic radials—which can often simply be copper electrical house wires—are the most reliable, predictable and lowest-loss choice for a ground plane radial system in normal installations. If you intend to use a ground-mounted, quarter-wave vertical antenna for your station, don't forget to include the time, labor and expense of an adequate radial system into your initial considerations. Many have tried to circumvent that requirement, but few have been successful! Most of the tuning and other end performance problems associated with backyard, ground-mounted verticals can be traced to inadequate radial systems.

Taking a hint from the commercial AM broadcasters may be one of the best examples. A typical commercial AM broadcast station tower—which can be either a quarter-wave or a five-eighths-wave vertical—will have one quarter-wave-length radial, usually made of heavy copper strap, for every three compass degrees around the tower. That's 120 full-length quarter-wave radials emanating from the base of the tower in bicycle-wheel-spoke fashion. At the low-end of the AM broadcast band, each radial can be over 400 feet long, but it's the only way for the broadcaster to be sure of good stability in the tower's feedpoint impedance, along with the very least amount in ground losses—which represents energy lost in simply heating ground. Rarely will hams go to those extremes in installing a ground radial system, but it does illustrate the importance of a good radial system if you expect consistently predictable results, which commercial broadcasters must. Normally, ground soil conductivity is just too variable for professional installations. I'm often curious if hams are really aware of this when I hear folks talking about the "simplicity" of installing a quarter-wave, ground-mounted vertical. I have to believe that most really aren't. A well-installed vertical is not an easy job. Wide variations in feedpoint impedance and antenna effectiveness are almost inevitable without a well-laid-out radial system. Tossing up a vertical is easy; putting in a ground radial system for the HF bands is not!

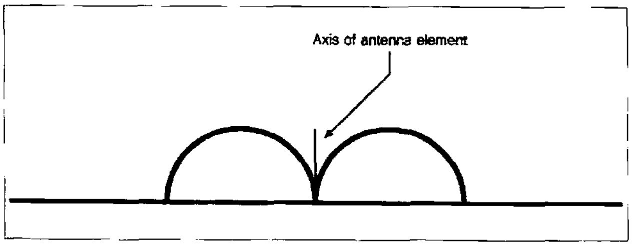


Fig. 5. Idealized radiation pattern of a 1/4-wave vertical, viewed from the side.

Less-than-ideal installations

Of course, if you can't achieve the ideal, and very few can, you can still install a compromise radial system and make many rewarding contacts; just don't be too surprised when results change with soil conductivity during wet and dry weather, or between sizzling-hot summer and freezing winter conditions. Different soil compositions can also play a role in the results you'll experience. There's been a good deal written about this subject, so you can find much more in the literature if you have the desire to learn more before installing a ground-mounted, quarter-wave vertical antenna for the HF ham bands. In general, however, the more radials, the better. If you put in as many radials as your property and other considerations permit, you'll know that you've done all that you can and you'll just have to work around whatever variations might result. Few of us live in an open field, with only antenna considerations to be addressed, like commercial broadcasting stations do.

50 MHz and above

A brief diversion at this point: At VHF and UHF frequencies, an effective ground plane is easily achieved with four or more drooping radials, right at the above-ground vertical antenna support itself, or from the metallic structure of the car or other vehicle, in the case of a mobile installation. VHF/UHF antennas are also often greater than one-quarter-wavelength, or even one-half-wavelength today; five-eighths-wave and

multiple five-eighths-wave vertical antennas are common, because of the potential gain that they offer by way of the more desirable vertically-compressed pattern possible with these longer antennas (**Fig. 6**). At VHF and UHF frequencies, the nearly impossible ideal situations that we face in the HF bands disappear completely because of the smaller sizes of antennas and their complementary radials at these frequencies. Instead, feedline loss considerations and height above average terrain become the dominant factors. The highest quality coaxial cable that you can afford and the greatest structurally-safe height that you can manage for a VHF/UHF installation are the keys to best performance at these frequencies.

Angle of radiation explored

Returning once again to the HF ham bands, we should address the subject of *angle of radiation*. This gets just a bit complex, and perhaps somewhat difficult to visualize, but it's important to have some acquaintance with the subject nonetheless. I'll be simplifying it as much as possible, so again, if you would like to delve deeper into it, there are references as to how to achieve to optimum angles of radiation in most of the antenna books.

The angle of radiation from an antenna within the amateur HF bands—those frequencies under 30 MHz—is important because it will be one determining factor in how far your signal can be expected to skip in the first, and subsequent, bounces off the ionosphere. Just like a ball bouncing off the cushion of a pool table, the angle at which your radio signal strikes the ionosphere will determine the equal, but opposite, angle that it's reflected back from the ionosphere—in general. This, in turn, normally determines how far the skip distance will be. I've said "in general" and "normally," because there are other factors involved, some of which we can't always predict, but this is the mechanism that we usually assume to be true.

In general, the lower the angle at which your radio signal's main lobe strikes the ionosphere, the greater your expected skip distance will usually be.

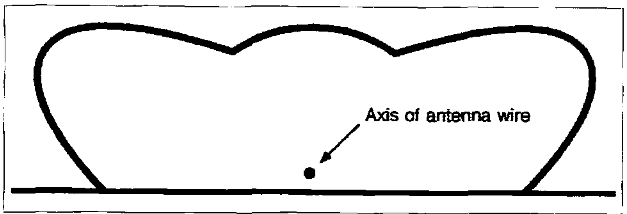


Fig. 7. Expected radiation pattern for a 1/2-wave horizontal wire-dipole antenna, mounted 1/2 wavelength above average ground soil composition, viewed from one end of the antenna wire's axis.

Antenna patterns can be complex—they're usually not the simple, clean-looking patterns shown in basic textbooks. An antenna can have a main or major lobe, plus numerous minor lobes and side lobes. This is especially true of an HF horizontal antenna mounted fairly close to the ground or close to other nearby conducting objects (**Fig. 7**). "Fairly close" usually means within a half wavelength of another conducting object.

Keeping a horizontal antenna at least a half-wavelength away from other influencing factors can be a formidable task in the average home-installation when you consider that it's 66 feet at 40 meters, 33 feet at 20 meters and even 16 feet at 10 meters!

How high is up?

Antenna books also tell us that horizontal antennas should be at least a certain height above the ground to produce the optimum angle of radiation that we'd like to expect on a particular frequency band. By the way, that optimum angle of radiation varies with the band in question, but those heights work out to be at least 45 feet high for a 40-meter antenna, 40 feet up for the 20-meter band and 35 feet high at 10 meters. It's generally agreed that heights of 40 to 70 feet are good compromise elevations for reasonably predictable long-distance work on the bulk of the HF bands.

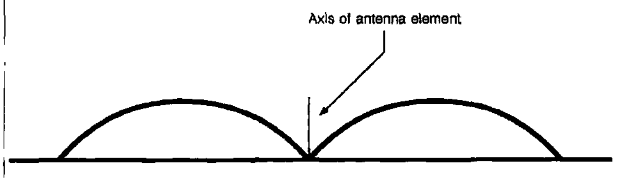


Fig. 6. Idealized vertically compressed radiation pattern of a 1/4-wave gain-designed antenna.

Perfection is elusive

What happens if you can't get a horizontal antenna up nearly that high? Before you give up, I'll add—as in the case of radials—that this is the ideal. Lots of antenna schemes will work, even at the lower frequency HF bands, and on normal city lots—just don't be surprised at less-than-optimum or less-than-totally-predictable results. Many hams have antennas located much closer to the ground and to other conductive surfaces (houses, garages, outbuildings, etc., which often have aluminum siding or other conductive surfaces or structures), than the books suggest, and they still put out respectable signals. The benchmark figures shown above are simply what we should aim for to achieve optimum results. But this is real life, and often our aims and our eventual realizations are very much different, aren't they? Antennas much closer to the ground and to other surrounding objects will still work, but not perhaps quite as the textbook says that they should. One of the challenges of ham radio is making do with less than perfect layouts, both inside and outside the ham shack. It's usually pretty easy to design the ideal system if you have an unlimited budget and unlimited room to do it in; it's much more challenging—and often more rewarding—to accomplish similar feats using less orthodox setups. Hams have been known for this right from the start and it's become something of a hallmark of the hobby.

Again, it's not that a low-to-the-ground HF horizontal antenna won't work; it's just not going work optimally—but that's okay as long as we understand why and if we don't set our expectations higher than our antennas!

Angle of radiation in vertical antennas

We've looked at how height above the Earth affects a horizontal HF antenna, but what about a ground-mounted vertical? You've probably heard that one of the attributes of a vertical at the HF

frequencies is its low angle of radiation. That's because a vertical antenna's signal launch angle isn't as adversely affected by the ground beneath it nearly as much as in the case of a horizontal dipole installation. In fact, a vertical can be right at ground level and still provide a reasonably low signal launch angle. It's often cited as the reason why many hams choose that type of antenna when they have limited space, coupled perhaps with the inability to erect a tower or other tall structures needed for horizontal arrays. But as we noted before, the installation of a vertical isn't exactly free of problems, given the need for an effective ground-radial system. Even with that requirement, it may still be the best choice for an individual's particular circumstances; it's a matter that you'll have to decide for yourself based upon your own property restrictions and other physical considerations.

By understanding both the advantages and limitations of each choice, you should be armed with enough information that few surprises will await you once you've made a decision. The best surprise is no surprise!

Near-field effects

The presence of other nearby conducting obstacles is another matter altogether. A vertical's pattern—and perhaps tuning—can often be affected by other buildings and structures in the electrical near-field of the antenna, and most affected when they're within a half-wavelength of the antenna. Again, it may be impossible to avoid those near-field structures entirely, especially down on 40, 80 and 160 meters; again, we do the best that we can under the circumstances and work around any less-than-perfect results. It's also been said that any antenna, as long as it's able to be matched reasonably well to the transmitter and is well enough away from children and pets so that it's safe to operate, is much better than no antenna at all! It's very true. The operator must, however, be realistic with regard to how well any compromise antenna set-up will work, and exhibit some degree of patience when competing with others on the band whose antenna capabilities may be superior to his or her own. That, too, comes with knowledge of the theory and practical experience with a given installation.

Gain antennas

Changing gears a bit, I've not mentioned gain antennas to any degree so far. A horizontal beam antenna does provide gain, and can basically be thought of as a horizontal dipole with other near-field resonant elements placed to strategically alter the dipole's pattern in a desirable way; normally a beam concentrates most of the energy in one given direction, while restricting its radiation and pickup in all other directions. That's the theory, anyway! Beams aren't perfect, but they can do a very respectable job in accomplishing that objective. The major lobe of a well-designed, properly installed beam, is definitely concentrated in one direction only. There are minor side lobes, and some radiation from the rear of the beam, but most of the signal is radiated from the front as it's supposed to be. The very same conditions hold true for receiving, so beams can be used to reject interfering signals from other directions while providing varying degrees of gain for those in the favored direction—kind of a two-for-one bonus! The more elements a beam has, the greater its potential gain, but the narrower its beamwidth also becomes. Think of it in terms of a telephoto lens on a camera; it brings in objects from farther away, but also must be aimed more accurately.

What about gain in vertical antennas? As mentioned previously, gain in a VHF or UHF vertical is easily accomplished today with designs taller than one-half-wavelength, but in HF antennas, it becomes a matter of excessive overall height and the antenna would soon become too tall for most people to handle. It can be done, but it gets unwieldy. Gain and front-to-back rejection can be accomplished by installing two or more additional fixed vertical elements in beam-like fashion, but then you have to choose which direction to favor, because it isn't rotatable. Rotatable VHF/UHF vertical beams are quite practical though, and often used on those bands. In HF terms, however, adding ground-mounted vertical elements to achieve beam conditions becomes tricky; the additional vertical elements must be fed via phase-shifting networks that would not lend themselves to multiband operation very easily. I've mentioned it only because it is possible, and some AM broadcast stations employ this idea every day. Since broadcast stations are assigned just one particular frequency, they're often required to protect another station, some distance away but on the same frequency, by using several towers, fed out of phase, to provide a beam-like pattern along with minimal radiation in a certain direction—the direction of the other station being protected. But it's a juggling act, and not especially practical in ham radio terms. From a purely practical standpoint, think of HF vertical antennas as not having any gain—and probably a certain amount of loss—when compared to a full size horizontal dipole because most ground-mounted verticals are shortened trap-type designs to keep their size (height) down. Shortening an antenna reduces its radiation resistance—which is undesirable—and all traps introduce some loss. But then, the favorable angle of radiation from a vertical may at certain times more than make up for its lack of gain.

Radiation resistance, by the way, isn't a negative factor as the term resistance might suggest. All antennas need a certain amount of radiation resistance to function—it's part of how we explain what happens to the RF energy that's radiated into the air.

Additionally, there's the question of using horizontal-to-horizontal or vertical-to-vertical antennas. On the HF bands, it's many times a moot point. For line-of-sight communications it's important to maintain the same polarization, but once a signal begins to be reflected by the ionosphere, the polarization question is usually meaningless because polarity is shifted with each bounce encounter. And it doesn't always seem to be an exact 180-degree shift. In fact, most of the fading on HF skywave propagation can be attributed to polarization changes rather than actual signal strength variations. One only needs both a horizontal and a vertical antenna to switch between to prove that to themselves.

The half-wave vertical

Finally, in the category of HF vertical antennas, there also exists a shortened, trap-type of half-wave vertical. They're commercially available and offer the

advantage of being ground-independent, i.e., not requiring an extensive ground plane, because they are already half-wave designs. A half-wave vertical can be fed at its center with 52-ohm coaxial cable directly or via a balun, just like a horizontal half-wave dipole. Some designs permit end-feeding with regular coaxial cable via a special low impedance to high impedance matching network right at the antenna itself. Any antenna displays a high-voltage, low-current condition at the very end of the radiating element. This translates into a high impedance at the antenna's end. Since our transmitters and coaxial cables are low impedance, they can't be tied directly to the end of an antenna without special considerations. That's where the special matching network mentioned comes in. It allows us to end-feed an antenna without ill effects on either the coaxial cable or our transmitter. In addition to not requiring an extensive radial system, a half-wave HF vertical can also be mounted up higher in the air if you choose, getting the high-current, low-voltage center of the antenna—which does most of the radiating—up above some of the surrounding obstructions. This can have a positive influence on the overall effectiveness of the antenna and can often be a worthwhile factor to consider if your installation plans permit it. By far, however, the biggest advantage to a half-wave design is its freedom from the need of an extensive radial system, usually making its installation much less involved. Just be sure to keep any close-to-the-ground mounted half-wave antenna protected from coming in contact with children or animals. Non-conducting fencing works well. Remember that the end of a half-wave antenna can be a RF high voltage point. Safety is rarely overdone.

Loop antennas

There are many antenna designs that have been tried and written up over the years, by hams the world over. Most are just variations on those already mentioned and go under the names of slopers, inverted vees, bent dipoles, etc. One relatively new design is worth mentioning, since it's now available commercially as well—the compact HF loop antenna. Loops have been around in various forms for some time, but the low-resistance, remotely-tunable, wide-band coverage loop is relatively new. It uses a very low-loss metal loop, about three feet in diameter, and is integrally coupled to a remotely controlled tuning unit. The package is small for the frequencies that it's able to cover, but keep in mind that loops have always been very high-Q devices, meaning that they must be retuned whenever you change frequencies even a small amount. That's not a tremendous problem when the loop is remotely tunable, but it does present another condition that you *must* meet when skipping around the band. Present-day commercial loops also have definite maximum power restrictions—usually in the area of 150 watts—so the use of an amplifier with a loop is out of the question right now. Most currently available loops will not operate below 10 MHz either, so the 40, 80 and 160-meter bands are out of reach with these antennas. Loops can be mounted horizontally, giving omni-directional (all direction) patterns, or they can be vertically mounted and rotated for a bi-directional (two direction) pattern. They are said to provide comparable performance to a basic dipole design. As with all new designs, it's best to talk to someone who has one and learn of their experiences before making a final decision.

As long as the restrictions mentioned here are kept in mind, loops certainly seem capable of providing HF antenna possibilities in restricted-space locations where operation below 30 MHz might not otherwise be possible.

Some final thoughts

This pretty much covers the various types of HF antennas normally available to us as amateur radio operators. As you can see, there are several basic design alternatives to choose from, and a seemingly endless number of variations on these basics. Experimentation with different antenna types is possible without tremendous financial investment. At the same time, an effective antenna will probably do more for your signal per dollar than any other modification that you can make to your station.

A more effective antenna will enhance both your transmitted signal and all received signals with the same effort, and that's hard to beat from any point of view. As mentioned at the beginning of the article, this has been a general discussion, with the new ham in mind, and by no means is it a complete treatment of an extensive subject. I've simply tried to put some of the basic information in logical order so that it can be more easily digested by the newcomer to ham radio. It seems that over the years that I've been involved in the hobby, more articles have been written about specific antennas than any other single topic! I'd encourage you to do much more reading on the subject in the various books and magazines available, and be assured that I'll continue to do the same. I also think you'll find that antennas are an extremely interesting topic for discussion—over the air or in person—among most hams, each one having their own favorite variation on the basics. Few other subjects will generate as much conversation as antennas will among most hams; it's interesting to see how staunchly certain design variations will be defended by their devotees. As you experience more and more of the hobby, your knowledge base will expand along with it, and it's my hope that this piece will have helped to put some basic perspective into that process.

See sidebar next page

Some Practical Considerations for Your First Antenna

Here a few considerations to keep in mind when installing your first ham antenna.

•Talk to as many experienced hams as possible, getting their opinions and experiences with as many of the various antennas as you can, via clubs, hamfests, magazines and on-the-air contacts. Someone else's trials and failures can save you untold amounts of time, money and wasted effort in antenna decisions. Also, try to find someone who has actually used any commercially-made antenna that you might have your eye on, before purchasing it. Generally, once you've bought it, it's yours; you can't test drive something like an antenna before final purchase.

•Use only wire designed for antenna construction for a horizontal wire dipole, it will last longer and stretch less than general-purpose wire.

•Try to use only metal fittings that are intended for outdoor applications and will provide a safe strength-margin factor. If you're forced to use steel or other fittings that are subject to rust and corrosion, seal them with a protective finish and touch up that finish on a regular basis. It's safer and makes disassembly for maintenance, modification, or removal so much easier.

•Use high-quality insulators between the ends of the antenna wire and any supporting rope extensions; remember that the end of an antenna is a high-voltage, high-impedance point; also, use rope that's meant for antenna installation for the longest outdoor life expectations.

•Use high-quality coaxial cable, especially for all outdoor runs, preferably cable with non-contaminating outer jacketing material and good shielding-coverage qualities. Make sure that your coaxial cable is rated well over—two times—the power level that you expect to be running both now and in the future.

•Spend a bit of time practicing the correct method of coaxial cable connector installation before finalizing your new antenna system, preferably under the tutorship of an experienced fellow ham. It could save you a good deal of troubleshooting time later.

•Make all electrical connections as waterproof as possible. It's very important that coaxial cable be watertight throughout its entire length and that special attention be paid to waterproofing any connection points. Any water at all inside of the coaxial cable will reduce its effectiveness as an RF transmission line. Even soldered connections exposed to the elements will deteriorate faster than you might think. Waterproofing effort is rarely ever wasted effort.

•Keep any wires well-protected and out of the way of children, pets, and passers-by.

•Be sure that all building codes are followed, with regard to lightning protection, grounding and structural soundness of your antenna installation; your insurance may not cover costs associated with accidental losses if you don't. It will also allow you to sleep much more peacefully.

•Keep your local weather in mind when designing and installing any antenna system on your property. Some antenna designs and structures are simply not practical for all weather and wind conditions that can occur in every area of the country. Ice formed by freezing rain can add tremendous weight load to wire and beam antennas both.

•Don't put up more antenna structure than you can reasonably live with from both an esthetic and a maintenance point of view. Always get help when faced with a two—or more—man job.

•Include semi-yearly antenna inspections as part of your spring and fall outdoor chores. It's far better to locate a potential problem yourself than to be forced off the air by Mother Nature—I always remember that commercial about not being able to fool her!

•Lastly, and perhaps most important of all: Take your time, making every detail of the installation as professional as you can. It pays off, over and over again—but be prepared to make a few mistakes along the way; we all do!

NEVER SAY DIE

Continued from page 63

of most sprays, but on fruit you're going to eat without peeling such as strawberries, raspberries, grapes, and such, you'll be a whole lot safer if you rinse them in a silver colloid solution to kill off any unwanted passengers such as the *E. Coli* bacteria, which has recently made thousands sick and even killed a few people.

We'd be a lot healthier if our crops were being grown on land that has the minerals the plants need. The Hamacker-Weaver book in my guide gives the gory details, as does *Secrets of the Soil* by Chris Bird. You either add the missing minerals to your diet in pill form or your immune system will gradually peter out, and so will you. Weaver says he's eating a teaspoon of rock dust every day, which is a nitty-gritty solution to the problem.

Oh yes, you really ought to invest $1.50 in Dr. Supkow's 48-page book, *Rock Dust and the Environment*, Stardust Foundation, 400 Grove St., Glen Rock NJ 07452.

Shooting Kids

A recent PBS program showing how wild horses are tamed in minutes using a new technique also showed the same approach being used to help autistic children. They mentioned that about 15 out of every thousand kids is autistic. Hey, that's 1.5%! How do you like those odds for your kids?

An article in *The Townsend Letter for Doctors* carried a recent item about the link between autism and the DPT (diptheria-pertussis-tetanus) shots. The pertussis element of the DPT vaccine has long been suspected to cause autism.

It was a tetanus shot that damned near killed me when I was a kid. I was unconscious and delirious for almost a week and the doctor apologized for not testing me for an allergic reaction before giving me the shot. He said the next one of those would probably kill me. So I wasn't particularly surprised when the Navy medics did their best to give me another tetanus shot despite my protests.

All immunization shots present a chance for serious injury or death to your child, so my advice is *not* to sign any school waivers of responsibility for your children. Don't let 'em get inoculated. And if you have been brainwashed by the medical mafia into believing that immunization shots are beneficial, then either do your homework with the books, at least the Walene James book I've recommended, or say "baaa."

Reinventing Hamfests

Hamfests are slowly drying up and blowing away. And for some good reasons. So let's take a look at 'em and see if we can come up with some ideas to help bring hamfests back to life, and maybe even get them to help reinvigorate our moribund hobby.

There are seven groups of people involved in hamfests, each with different goals and needs which must be satisfied ... or else! (1) The hamfest committee. (2) The commercial exhibitors. (3) The flea market exhibitors. (4) The ham attendees. (5) The speakers (entertainers). (6) The *prospective* ham attendees. (7) The suffering wives of monomaniacal hams. It's been proven endlessly in recent years that "if you build it they will come" is baloney. Hamfest committees have been building hamfests all over the place and the hams haven't been coming in greater and greater numbers.

As a potential exhibitor I have to see enough benefit to make it worth my while to spend the time and money it takes to exhibit. Sure, Dayton is BIG, but it is also almost terminally disorganized. Now that's a challenge for the hamfest committee. Yes, of course I have some ideas on how to reinvent this whole mess.

Hamfests need to cater to all seven of the groups, so let's look at them.

Commercial Exhibitors

There are two basic groups of commercial exhibitors. One is the manufacturers of ham equipment and accessories. The other is the dealers selling all this stuff. And, in recent years, also dealers selling computer hard and software. The manufacturers have a story to tell, so generally they have their new equipment set up and do their best to answer questions and explain what's new and different about it.

But during the few hours of the hamfest how many individual hams can an exhibitor reasonably expect to talk with in a meaningful way? A Saturday hamfest runs about eight hours. One person in the booth has to take at least three to five minutes per potential customer if he is going to do much in the way of explaining the new gear. That's around 12-15 per hour, unless he gets hung up with someone who has an endless supply of questions. Which happens all too often. Times eight is a maximum of around 120 a day, unless the poor guy takes off a few minutes for lunch.

Now divide that into the cost of the exhibit booth space, shipping the exhibit to the hamfest (and back), plus the cost to fly in the sales person, the hotel, rented car, and meals. That'll give you a good idea of why 90% of the potential exhibitors skip most hamfests. They are a terribly expensive and inefficient way to sell the product.

Is there any way to make hamfests so they can do a better sales job for manufacturers? Of course there is. When I organized the Hudson Division Convention booth sales I offered each manufacturer a 20-minute infomercial opportunity so he could show and tell to several hundred potential customers all at once instead of trying to deal with them one at a time. They loved it and the equipment sales at that hamfest set all-time records.

When I called manufacturers to sell them a booth and offered them the opportunity to do a show-and-tell, few turned me down. It was a powerful sales tool.

But the commercial exhibitors should also get some free help in setting up and tearing down their booths. They should get fed and watered through the day. They should have a quiet exhibitors' lounge to rest or talk business. If hamfests make it fun and profitable to exhibit, the commercial exhibitors will be there. And they tend to attract more attendees ... and dealers.

Speakers

You'll attract better speakers if you can guarantee them a good audience. Most hamfests publish the speaking schedule in the hamfest program and think their work is done. There should be posters put up to remind the attendees of who is speaking, about what, and in which room, when. There should be clearly audible announcements. The sorry fact is that few hamfest attendees bother to stop and read the program during the hamfest, and even fewer after.

I used to run ads in hamfest program booklets, and it was rare that an ad ever resulted in any subscriptions—no matter what offer I put in the ad. It finally dawned on me that since there's rarely anything of interest to read in a hamfest program, hardly anybody ever bothers to read 'em. They take 'em home, throw them up on a shelf and that's the end of it.

Yes, I enjoy talking for two hours or more, and I don't come even close to running out of material. But I recommend that most talks be kept to 30-45 minutes. After all, the hamfest only lasts for a few hours, and the attendees want to see the exhibits, shop the flea market, attend a few talks and see how far down they can bargain the dealers on that new rig they want. Listening to four one-hour talks pretty well kills a whole day.

If you want top speaking talent you're going to have to pay the travel expenses for your key speakers. Travel, hotel, meals, and a rental car. That's what most conferences do. That's the treatment I get from the Tesla Society, the Global Sciences, and so on for my talks.

You'll probably bring the speakers in on Friday for a Saturday talk. Why not organize a ham dinner for that evening so any interested ham can have dinner with your guests? Charge 'em a little extra to cover the guests' meals. If you have anyone in the local area with a boat or plane, and there's time, maybe a little extra entertainment for your key speakers?

Why not make it a point to video and audio tape the talks? The videos can be shown at local club meetings for any members who missed the talks. And if the talk is a rouser you might be able to sell the audio tapes, with a royalty to the speaker. When I talk at Dayton I usually draw 300-400 in the audience. Then, when I sell a tape of my talk, I can sell a thousand or more copies. In St. Louis, where Bob Heil did a lot more to promote my talk, there were over a thousand in the audience.

Hamfest Committees

You want to pack the place. This means advertising in the ham magazines. It also means getting the word out locally so that every even partially-live ham within driving distance will be there, plus as many kids as you can get from the local schools who have shown an interest in hamming. Or computers, for that matter. Most hamfests these days are around two-thirds computer-oriented. Well, with every ham having one or two computers, plus a zillion young computer hobbyists, why not?

Get a list of every ham club within driving distance and send them flyers. Send their newsletter editor news releases every month for six months before the hamfest. Who's going to be exhibiting. Who'll be giving talks and about what. What have you for the packeteers? The satellite ops? The DXers? Contesters? And so on. Do you have anyone who can get around to clubs and talk up the hamfest? Are you going to have a CW copying contest, with certificates? A 2m antenna strength contest? A hidden transmitter hunt? What prizes have you rounded up?

Be sure to keep your local papers supplied with news. Ditto the news desks of the radio and TV stations. If there are any opportunities for interviews, get your best talker on there and get copies of the video to nearby clubs to show at meetings. Build the excitement.

Try to get your clubs to set up exhibits which will show newcomers to the hobby what packet is about, repeaters, ham satellites, ATV, slow scan, and so on. The more we can use hamfests as a way to help get youngsters interested in the hobby, the better chance we'll have of keeping our ham bands.

If you have a really good talker such as Jean Shepherd K2ORS, try to get him there a day early and schedule him on as many local talk and news shows on radio and TV as you can. I'm very good at this sort of thing too, in case you've asked me to be there. Maybe you've heard Art Bell W6OBB and me talking ham radio on his talk show, which reaches all 50 states.

Don't forget posters in any ham stores within driving distance. And flyers. Get flyers to any other nearby hamfests or other ham events.

Food

They're going to be there all day. Maybe two days. So have some good food for 'em. Find some vendors for popcorn, frozen yogurt, and the usual hot dogs and hamburgers. How about barbecue? Mmm, that smells good! Soft drinks, snack food. Beer is a bad idea.

Those Suffering Wives

Why make XYLs hate ham radio any more than they do already? Call a meeting of the hamfest committee's wives and see what you can put together to make the hamfest fun for the gals too. Looking at the 1000DX transceiver isn't going to send them into an orbit like it does the OM.

Bringing In The Techs

With the ham population heading toward 90% Techs ... permanent Techs ... maybe it's getting time to get a group of these guys together and see what they think will bring in your local 2m repeater-user denizens in droves. How about a panel discussion of VHF rigs? HTs? VHF antennas? The hamfest programs I've seen recently have had little to attract the Techs. But then the hamfest committees tend to be made up of old-timers, so Techs aren't given a lot of consideration.

Hamfests can be made to work again if they're kept relevant and diligently promoted. Old products have to be updated to stay in business, and so should hamfests.

Cleaning Up

A reader suggested a way for us to get the dirty-mouth hams to clean up their acts. Actually, as he pointed out, I proposed this approach some time ago, but as far as I know no one has bothered to follow up on it. Now, with the bands getting worse all the time, and with the understanding beginning to percolate through some very thick heads that neither the FCC nor the ARRL is going to do anything about this situation, perhaps this more direct approach to solving the problem will fly. Hey, we're

Continued on page 88

Number 82 on your Feedback card

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119
[clhough@pacbell.net]

Surveying the surplus coax switch

This month, I want to get into the subject of coaxial switches and different types of RF switches in general. As you know, an RF switch is, electrically speaking, nothing more than a simple toggle switch activated by either a mechanical motion or a solenoid relay action. This motion, either electrical or mechanical, is used to transfer the contacts from receive to transmit in normal applications.

For low frequencies, the task can be performed by an open-air type of switch mounted in a suitable metal container equipped with coaxial connectors. Wiring at low frequencies is not critical. Going to the extreme in low frequency operations—say, in the 1 MHz area—the entire operation can be accomplished with long wire leads and a suitable manual switch. In the very early days of amateur operation, this was just the method used to switch an antenna from transmit to receive or between different antennas. It was inexpensive, available, and it worked well.

Today, most of the RF switching is taken care of with solenoid-operated switching devices. These devices started to show up in designs before World War II. I tore apart many different surplus military transceivers and high power transmitters to obtain parts to use in my early amateur construction projects. Not having won the lottery, nor having deep pockets, I had to be frugal in my radio ventures and thus used these surplus resources to the max.

I can remember dismantling ART-13s, ARC-5s, and other HF units, as well as VHF counterparts to the ARC-5 line and even some military surplus cavity units in the low frequency microwave area of 1000 MHz. This surplus material left me with a wealth of component parts, as well as experience in stocking a large junk box for

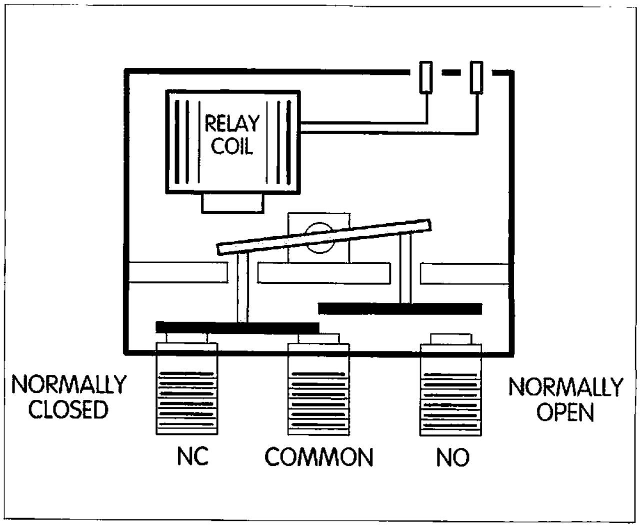


Fig. 1. Microwave switch internal construction. Note balanced actuator arm that pushes bar contact from grounded out-of-circuit position to contact from one side of switch to center contact. Left or right side of switch operation identical. Typical frequency of operation from VHF to 24 GHz. Size of switch decreases to reflect increases in frequency.

construction projects. Material scrounged included tubes, fixed and variable caps, resistors, and any RF switches I could find.

Well, since I was quite smitten by VHF operation in those early days and they were within my price range, I salvaged the best coaxial relays I could obtain from these surplus sources. The switches I used were not ideal but they *were* on hand. They were full coaxial, except for one terminal which was a solder-lead type. Surplus being what it was, that was how it was used in the VHF ARC-5 radios I pulled the switch from. The relay was external to the metallic enclosure, and operated the armature which pushed an insulated bar into the box to transfer the function of the enclosed relay contacts. It was not ideal, but for surplus prices in the early '60s it worked well until something better came along.

The real primo coax relay was a Dow Key. It was much sought after, if you could afford one. The only other alternative was a glass vacuum RF switch that was removed from the high power HF military surplus radios. I never used these in VHF operation, but know now that in suitable enclosures they work quite well. In those early days, we did the best we could.

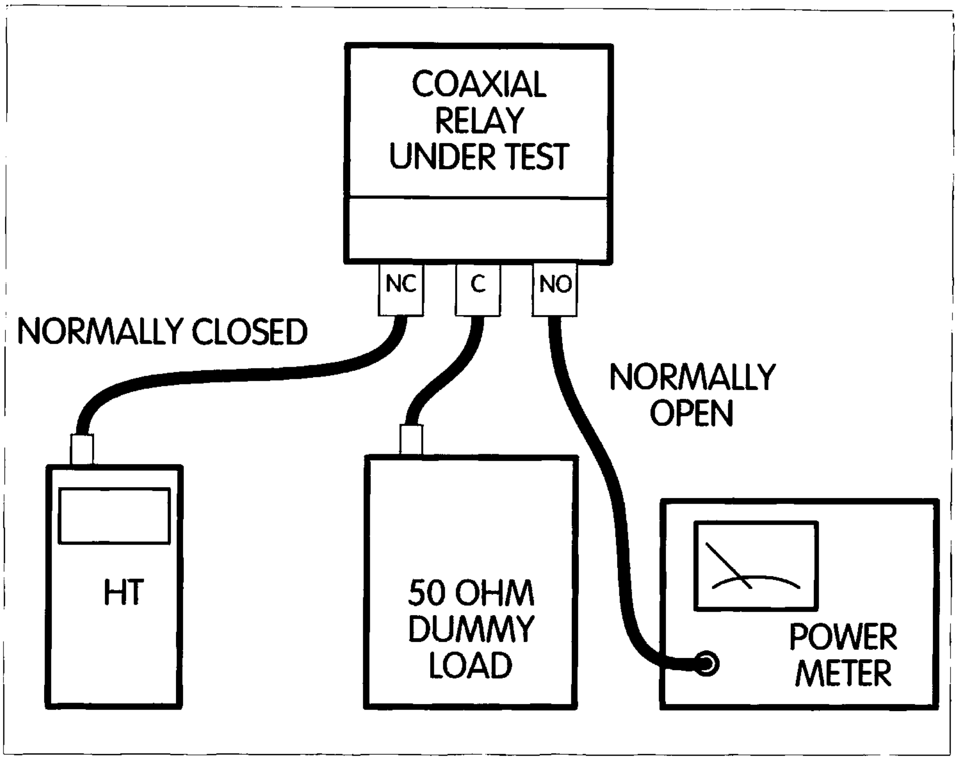


Fig. 2. Test setup to measure isolation between switch ports. Signal generator (transmitter) places power through contacts of switch. Power measurement made at open switch contact to verify isolation of switch. Isolation should be better than 50 dB for a good switch.

Today we have so many choices with commercial equipment—and not much relief in price unless you scrounge the surplus markets and swap meets looking for material. If you want quality and want it now, you have to pay for it. If you can assemble a shopping list and be willing to do some trading or swap meet looking, it will come your way eventually. It just might take a little time to fall into place.

What are your choices and what relays are the best for you? Do you even need a coax relay, since most of the transceivers packaged today provide all switching needed in a basic transceiver for HF or VHF/UHF operations? What can you do to evaluate just what is right for your situation? Well, the answers are not simple, as a little background material is needed to get you up to speed on what is required for a frequency by frequency and power level type of approach.

To start to evaluate coaxial switches in general, you first need to lay out just what you want to switch and list the frequency and power level involved (as everything changes as you get higher and higher in frequency). As frequency increases above 1,000 MHz, things get downright mean in what it takes to perform well. Also, power handling capabilities decrease as frequency is increased.

What is going on internal to the relays is much the same as with construction practices used at similar frequencies. At low frequencies such as 80 and 40 meters, open wiring with no particular attention to wire dress or position is required. (Look at antenna tuners, for example, to see what is allowed at a particular frequency.) As we get into 20 to 10 meters, it starts to get fussy with regard not only to lead dress but also the length of wire used to make connections. At 6 and 2 meters, connections used at lower frequencies will be called RF chokes and actually impede the flow of RF. On 6 and 2 meters, very short connections are a must.

As we get even higher in frequency, the components used in construction of a switch start to take on a very large fractional portion of a wavelength in physical size. When the dimension becomes large, the switch elements tend to radiate the energy they are trying to switch. In these devices, special precautions must be taken to eliminate cross coupling between unused switch positions and other parts of the switch. At low frequencies such as 1 MHz, these cross coupling questions are just as important, but due to the very long wavelengths involved, construction lead length is not critical.

What, then, constitutes good construction of an RF switch for modest power levels that will function at HF through 450 MHz? Let's examine what is offered for sale today and take a look at the internal structure of what makes a good manual switch.

What is a manual switch? Well, there are several being offered for sale today. Physically, the basic switch has one input and one connection path out and a switchable alternate path. SPDT—Single Pole, Double Throw—is the most common one.

Switches from military or commercial surplus include multiple outputs just like the Transco manual switch I described earlier. Most common types I see on the surplus market have 24-volt relay coils, SMA miniature connectors, and are intended for UHF through microwave frequencies. The miniature multi-output types are not rotary in operation but instead use an individual relay for each contact selected. The relays shown in **Fig. 1** are of the type I use at 10 GHz. The switch is about the size of a large postage stamp. Others similarly constructed (but much larger by a factor of about ten) use type-N connectors and work at lower frequencies and higher power levels.

For HF operation, a home-constructed switch might take the form of a heavy-duty ceramic rotary switch with contacts that are about 1/4-inch in diameter. Additionally, the ceramic switch spring

is constructed out of several layers of spring material and backed up with a heavy brass or plated-steel armature for the switch contact rotary section. This type of switch is typical of a surplus heavy-duty RF switch removed from older military surplus. Usually it is so heavy it must be mounted on a panel in order to operate the manual switch from one position to the other. It switches into position with a loud "snap" sound, making very evident it switched.

I would hesitate to use this type of switch above 20 MHz and rate it iffy at best near that frequency. An improvement would be to mount the rotary switch in a metal box and fix connectors for each switch contact. As you look inside the metal box of such a switch and its wiring, you can see that there is a certain amount of coupling between each section of the switch. In other words, there is still some coupling (poor isolation) between sections of the switch that are in proximity to each other. Think of the operation as coupling between a tangle of clip leads scattered on your workbench.

To test this isolation, you just run a test signal through the closed contact path and test at the open contact to see how much of the signal leaks through to here and its connecting leads (see **Fig. 2**). What you want to see is lots of isolation and very little signal leaking through. The measure of the loss is the rating of isolation, usually expressed as dB isolation. In this simple switch loss is low, giving it a poor rating above 20 MHz because of poor isolation as frequency is increased above a point. Operation at lower frequencies is quite proper.

The reason you want high loss between the switch contacts is that a transmit path might have 100 watts of power going to the antenna. The open contact is the receiver, and if the isolation is poor, an appreciable amount of power will be coupled into the front end of the receiver. This is not what we want to happen. With a receiver sensitive to minus 100 dB and transmitters with output powers in the 100 watt category (+50 dB), it is safe to assume that a great switch would have isolation in the 50 dB or better range to protect the equipment (receiver) it is switching.

Coupling (poor isolation) is the bane of any coaxial relay circuit. If the frequency is low, the extraneous wiring can be tolerated because the wavelength at these lower frequencies is quite lengthy and short hookup wiring techniques are tolerated. As the frequency rises, shorter wiring methods must be used to limit excess wiring and its associated coupling. All is not lost, as there are switch layouts that help to minimize coupling between switch elements and make them virtually invisible to each other.

What layout can we use to provide low coupling or high loss between adjacent elements of the switch? Well, when we think it out, it can be shown that the best switch would duplicate as best it could a manual coaxial connection. The switch would look in this scenario like a manual coaxial switch panel. The switch panel is one that is entirely made up of coaxial connectors and one patch cord (coaxial). When you wanted to select a new port, you would have to unscrew the connector and move the cord to the new port connector. Not very practical, but very efficient in minimizing coupling and effecting very high isolation, which is excellent.

What is needed is a mechanical contrivance that duplicates this action to obtain the very best in isolation and at the same time maintain almost zero coupling between ports—just like the previous coaxial connector-and-cord scenario. I am not dreaming, as some of you might suspect by now, but rather I am just trying to make you aware of what is going on and how important isolation can be.

The switch that conforms to this design principle is made by Transco. Its operation is exactly what was previously described in a manual-patch cord scenario. The switch I tested has manual operation and six possible output ports. It exhibits all the quality of the coaxial connector-and-cord operation in a very compact rotary coaxial switch. It uses a spring contactor coaxial hairpin, allowing contact in a coaxial environment with only one contact between the selected main input/output connector. To switch it to another position by manual rotary action, it has a cam action to unseat connections before reseating into the new selected position.

There is virtually no coupling between the main and unselected switch ports, due to the excellent shielding between master and selected rotary contact all done in a coaxial environment. This minimum coupling is accomplished by this cam-operated coaxial hairpin internal to the switch. In all respects this hairpin is just like unscrewing a connector and transferring it to another connector.

As far as isolation goes, the other connectors might as well be in the junk box as you cannot see them with this type of mechanical contact switching. The other unused connectors are out of the picture, electrically speaking. The selected path and its connector are totally coaxial and shielded from everybody else.

The Transco switch is quite robust; I have used it to 450 MHz with no problem. This switch must be bolted to something sturdy, as it does require a few pounds of pull to rotate the switch. You need this hard mounting in order to turn the switch by hand. It has quite a stiff cam action and produces a sharp "snap" sound (of the kind mentioned earlier) when the coaxial hairpin is reseated.

The relay that I show in **Fig. 1** and use at 10 GHz is quite small and uses miniature SMA coaxial connectors. The coax cable that is used has Teflon™ insulation and relatively low loss at these frequencies. As you can see in **Fig. 1**, when the relay has current flowing through the coil it attracts the armature to the pole piece on the coil. This activates the armature in a teeter-totter type of function and uses insulated push rods that raise one end and lower the other end of the switch contacts.

The unused switch contact is pulled toward the top of the switch's enclosed chamber and grounds out on top of the switch compartment. The other element is pushed into contact with the previously open contact and the center main contact. The process reverses when relay current is removed. The internal compartment where this switching action takes place is much like a very short section of air dielectric coaxial cable with the exception that its internal dimensions are square and the impedance is 50 ohms. The impedance is determined by the ratio of inner to outer conductors.

Think of this inner-to-outer ratio as quite similar to the ratio between coaxial cable and its inner and outer conductor. The action is quite the same. When the switch duplicates as closely as it can the coaxial environment and the internal elements are a fraction of a wavelength at the frequency of interest, it will function well. 73

Number 84 on your Feedback card

Homing In

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
[Homingin@aol.com]
Web: [http://members.aol.com/homingin/]

Low-cost monitor for the NorthScope

"Is that radar in your car?" I'm not surprised when visitors to the starting point of our hidden transmitter hunts (T-hunts) ask that question. The lingering yellow glow of the lines on my cathode-ray tube (CRT) display are reminiscent of radar scopes in pre-computer times. But these lines are signal bearings, not aircraft tracks.

Continued

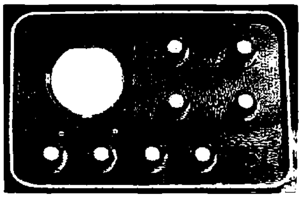


Photo A. The Heathkit Scanalyzer after repainting the front panel and replacing the grid screen under the CRT bezel with a transparent compass overlay. Next comes labeling. The hole at lower right will be filled by a future control.

This month's "Homing In" is the final installment of a series on north-referenced bearing readouts for radio direction finding (RDF). July's column covered remote heading sensor technology. An inexpensive fluxgate compass module gives you a dashboard indication of your mobile antenna mast position with respect to true north. With it, you can quickly tell if the bearing to a hidden T is steady or shifting as you drive on winding roads in the dark.

"Homing In" for August described an analog multiplier circuit that combines fluxgate compass and receiver S-meter signals to produce a "north-up" display of signal strength versus direction. I call it the NorthScope. Its polar plot simplifies the task of separating the direct signal from multiple reflections (multipath) in urban and hilly areas.

Like a radar scope, a north-up display must have persistence of several seconds so that the operator can "stack up" traces. That makes it possible to tell the difference between fluttering reflections and more stable direct signals. Ordinary oscilloscopes and computer monitors are not suitable because their persistence is only a few milliseconds. Surplus waveform storage oscilloscopes and medical monitors make fine readouts, but they require 110-volt AC power and are somewhat expensive.

A recycled boat anchor

I was searching the swap meets for parts to build a home-brew display when I discovered a '60s-vintage Heathkit SB-620 Scanalyzer. There, in one case, were all the hard-to-find items I needed—including the long-persistence CRT, mounting hardware, mu-metal magnetic shield, socket, panel, bezel, high voltage supply, and beam controls. What's more, the cabinet had plenty of room for the interface circuit with its front-panel controls.

Constructing a CRT display from scratch is possible. I built a bigger one for my high school science fair years ago, but surplus scope parts were much easier to find then. Nowadays, the modified Scanalyzer approach is far simpler and cheaper. They show up regularly in estate sales and at the three computer/electronics swap meets in my area. A recent issue of *Amateur Radio Trader* magazine had an SB-620 listed at $75. This appears to be a typical "street price." Be sure to get the manual, too.

The Scanalyzer need not be in full working condition, but the high voltage supply, CRT and beam controls (INTENSITY, FOCUS and ASTIGMATISM) should be functional before you begin the modifications. There are Internet mailing lists and Web pages devoted to "boat anchor" equipment and Heathkits that can help you locate an SB-620 and repair it if necessary. You will find links to these resources at the "Homing In" Web site. My site also has information on CRT sources and high voltage supply schematics for those who choose to build a monitor from the ground up.

The SB-620 has a 3RP7 high-persistence CRT with a 2-5/8-inch-diameter face (**Photo A**). This is quite suitable for a mobile display. I had considered the next size larger CRTs for the project, but electrostatically focused five-inch tubes are about 17 inches long, necessitating a deep enclosure. They also require much higher acceleration and deflection voltages than the 3RP7.

WARNING: Use extreme caution when working on your monitor. Voltages high enough to cause serious injury or death are present in the power supply, beam and deflection circuits. There is no substitute for caution, prudence and clear thinking when working with high voltage. Mount all circuits inside a grounded metal enclosure so that high voltage points are never exposed to the user during normal operation.

Turn off all power and wait for capacitors to discharge fully before removing the cover. With power off, short all capacitor terminals in the high voltage supply to ground with the metal shaft of an insulated screwdriver before touching any circuits. Observe all safety precautions including keeping one hand in your pocket when making adjustments and measurements with the cover removed. Do not work on HV circuits when fatigued or under the influence of medication or intoxicants. Measure high voltages only with instruments and probes designed for this purpose.

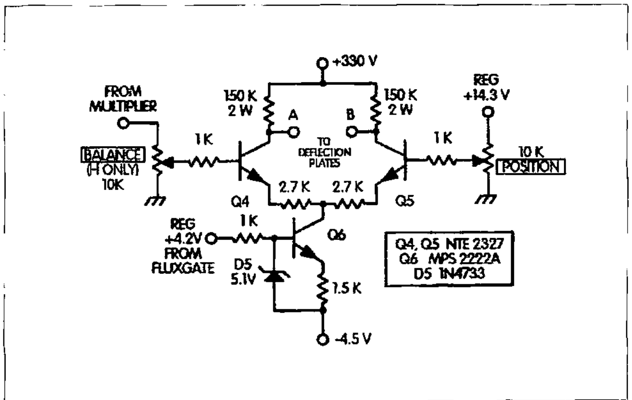


Fig. 1. Schematic of the new deflection circuits. Two are required, each with a spot positioning potentiometer on the front panel. A and B outputs of the horizontal (X) circuit go to the orange and yellow CRT socket wires, respectively. A and B outputs of the vertical (Y) circuit go to white and violet socket wires.

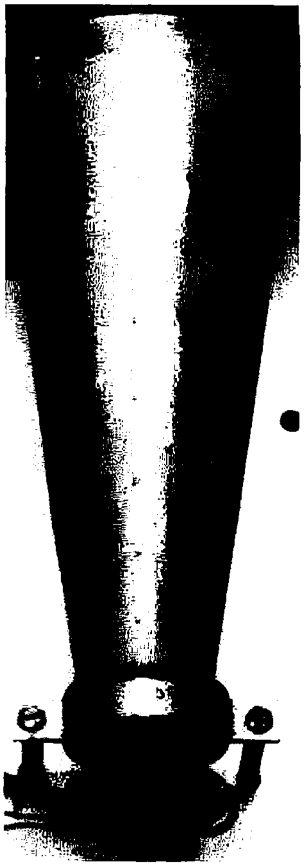


Photo B. Rear view of the CRT inside its mu-metal magnetic shield, with socket. Leave the shield on the CRT to prevent spurious deflection due to magnetic fields from the transformers.

Use care when handling a CRT due to its high vacuum. Do not

Photo C. Components in the CRT cathode supply are as originally described in the SB-620 manual. Note the long insulated bushing on the INTENSITY control. The piggyback switch is rewired for +12 volts.

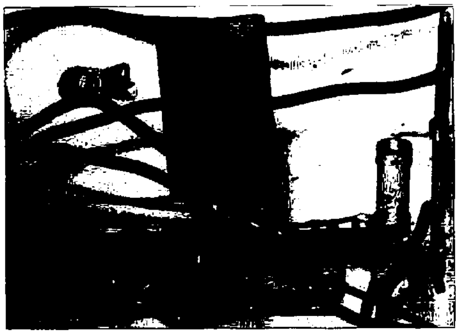


Photo D. This series regulator stabilizes the acceleration electrode and deflection supply voltages to prevent spot movement as vehicle voltage fluctuates.

strike, scratch or subject the CRT to more than moderate pressure at any time. A fracture of the glass could result in an implosion capable of causing injury.

Tubes out, ICs in

The first step in the SB-620 conversion is to remove all of the RF circuits, tubes, tube sockets and associated components, except for the CRT of course. The INTENSITY and FOCUS potentiometers are used as is. All other front panel controls are no longer needed. Replace and rewire them with switches and potentiometers for the new INPUT, BALANCE, HORIZONTAL POSITION, VERTICAL POSITION, SIZE and OFFSET controls.

Disconnect the violet, orange, white and yellow CRT socket wires at the chassis end, leaving the other socket wires connected to the supply (**Photo B**). Leave all power supply components and wiring intact for now. Note that the INTENSITY control has an extended insulated shaft and bushing. For high-voltage safety, be sure this is assembled per the construction manual and **Photo C**.

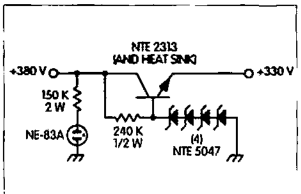


Fig. 2. Schematic of the +330-volt regulator. The NE-83A indicator and 33k resistor are on the original SB-620 front panel.

Build and install new X and Y deflection circuits per **Fig. 1**. A perfboard photo is in last month's "Homing In." The previously disconnected CRT socket deflection wires connect to these circuits. Except as noted, added resistors are quarter-watt. Higher wattage resistors must be used in some places for their greater voltage standoff capabilities.

There is only one BALANCE control, used in the horizontal deflection amplifier. It equalizes the X and Y path gains, compensating for the slightly higher horizontal deflection plate sensitivity in the CRT. When performing the alignment described last month, adjust the BALANCE control to obtain a perfect circle trace instead of a horizontal or vertical ellipse.

Only a few changes are required to the rest of the power supply and beam circuits. Rewire the on/off switch and main fuse to open the vehicle's DC input instead of the main transformer primary. The DC fuse should be two amperes fast-blow. Negative supply (-4.5 V) for the LM324 comes from the original DC heater source (D8-D11 and C54).

Deflection supply and CRT astigmatism (Anode #2) supply voltages are regulated for mobile operation. The +330-volt regulator circuit is in **Fig. 2** and **Photo D**. I built it on an added eight-terminal strip next to the five-terminal strip at position E on the chassis. Be sure to provide heat-sinking for the transistor, but do not ground the sink. Remove the wire from the top of the astigmatism control (lug #3, farthest from the power input grommet) to the positive end of C53-C in the power supply. Connect the regulator input to the positive end of C51. The regulator output goes to lug #3 of the astigmatism control and the common point of the four

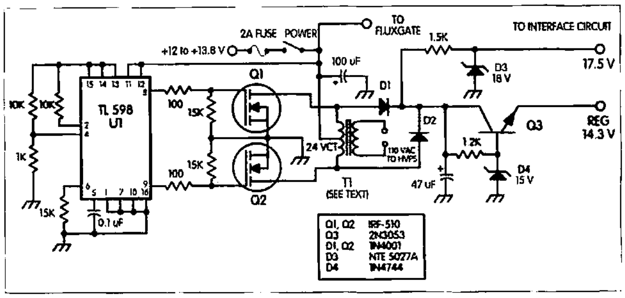


Fig. 3. Schematic of the DC-to-AC converter. Outputs are 110 VAC square-wave for the high voltage supply and positive DC for the analog multiplier circuits.

150k collector resistors in the deflection circuits.

Powering the scope from a car battery is easy with the circuit of **Fig. 3** and **Photo E**. The TL598 converter IC is available from distributors of Texas Instruments™ semiconductors. It generates alternating pulses at 500 Hz to drive the two switching transistors. Although the TL598 has provisions for voltage and current feedback, I found it to be unnecessary in this application.

Mount the transistors to the chassis with supplied insulating hardware. The transformer (Triad F-45X) is connected "backwards." Its 24-volt center-tapped secondary connects to the transistor drain pins. Output at the primary is 110 volts square wave. If you can't find the Triad transformer, you can substitute Radio Shack™ 273-1512, but output voltages will be about 5% lower.

There is no problem feeding the square-wave chopper output into the main transformer primary to operate the scope instead of a sine wave. The RMS voltage at the CRT heater is very close to the wall power value with normal +13.8-volt input. The capacitor-input high voltage supply filters produce about 35% lower voltages, compared to AC power. This is an advantage because it lowers the CRT deflection voltage requirements such that solid-state drivers of **Fig. 1** are practical. Spot brightness is more than adequate at night, but add a sunshield for daytime hunts. You can set the INTENSITY control to maximum without burning the CRT phosphors.

Except for the special components mentioned above and the NTE semiconductors, all of the new parts should be available at your local Radio Shack. NTE transistors and diodes are sold by local parts distributors nationally. My junk box played a large role in parts selection for this project. Experienced experimenters should feel free to make appropriate substitutions.

With modifications completed and the analog multiplier circuits installed, your NorthScope should be ready to align and operate. Be sure to check your work thoroughly before the first "smoke test." Warm-up time of the CRT is about 20 seconds. DC supply current is 600 milliamperes in normal operation, not including the fluxgate compass. Follow the alignment procedures given last month for the fluxgate-to-CRT interface.

Better than a Doppler?

Fans of Doppler RDF units may argue that their method is

Photo E. The DC-to-AC converter circuit includes a step-up transformer, two field-effect transistors bolted to the chassis and a 2-1/2- x 1-1/2-inch perfboard with the IC and associated components.

Number 87 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 E Chateau
Payson AZ 85541

The most disappointing days (VP) for DX propagation are expected to occur during the first and last two weeks of this month, particularly the 4th, 20th, 26th, and 27th, with the occasional appearance of minor to major magnetic storms in the ionosphere. Other severe geophysical upsets may also accompany these days, and an unsettled-to-active ionosphere (P) is likely as well *surrounding* these days (see calendar).

Try to use the 10-day period between the 8th and 18th to your best advantage, but always remember that propagation is where and when you find it. Forecasts made for the period between two sunspot cycles, as now, are always uncertain and subject to sudden increases in solar flux values, particularly surrounding VP days on your calendar. Stay alert and *listen*. We're overdue for some DX surprises.

10–12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15–17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the US.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30–40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar). Short-skip during darkness to 1,500 miles or more.

160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked G on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet.

SEPTEMBER 1997

SUN	MON	TUE	WED	THU	FRI	SAT
	1 F	2 F-P	3 P	4 VP	5 P	6 P-F
7 F	8 F-G	9 G	10 G	11 G	12 G	13 G
14 G	15 G	16 G	17 G-F	18 F-P	19 P	20 VP
21 P	22 P	23 P	24 P	25 P-VP	26 VP	27 VP
28 VP-P	29 P	30 P-F				

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			60	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		60	80	40	40	40	40	20	20	20		

faster than the NorthScope (hundreds of bearings each second) and that Dopplers latch onto short transmissions with ease. PIN-diode-switched Doppler arrays have no moving parts and are much less conspicuous than a big beam. Dopplers are a bit easier to use in a fast-and-furious T-hunt because they have fewer controls to adjust.

Those claims are true, but a beam/CRT configuration tops Dopplers in other important respects. A high-gain antenna makes it much more sensitive, so you can hunt stations at much greater distances. With a twist of the quad's boom, it can track horizontally polarized foxes with the correct polarization, while Doppler users are always stuck with vertical antennas.

The biggest advantage of a scope is its ability to analyze multipath and multi-signal situations. It separates the directions of direct and reflected signals. On the other hand, a Doppler set must give a single bearing indication for each rotation of its array, no matter how many signal components are present. A polar plot gives a moving picture of the channel that clearly displays multiple stations. The operator can identify each one by ear from the receiver audio as the beam goes around. You'll appreciate this feature when you are jammer hunting, because it becomes easier to separate the jammer's signal from that of the station being jammed.

One more plus for the NorthScope: Multiple overlaid sweeps on the CRT will show bearings of single sideband stations and pulsed noise sources. Dopplers, on the other hand, will not, because they require carrier-type signals. They aren't designed to track emissions with large amplitude variations.

NEVER SAY DIE

Continued from page 82

supposed to be self-policing, right?

It's simple, really. All you do is make a tape of the offender offending, then make copies and send it to his neighbors with a note explaining who is on the tape, and giving his phone number so they can help us get the idiot to shut the heck up.

If you have a phone ROM it's real easy to get the names and addresses of the neighbors on his street anywhere in the country. If you're in the same area you may be able to send a tape to his employer, in-laws, and so on.

I see no possible benefit in identifying yourself, and plenty of downside. But with no sheriff to help us, vigilante justice seems called for.

Birthday Present

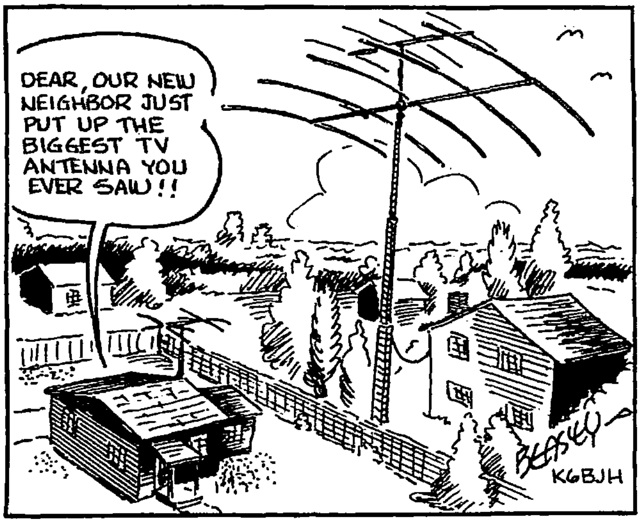
Yes, come to think of it, there *is* something you can get me for my 75th birthday (Sept. 3rd). Any real old-timers, who have been reading my editorials since I first started publishing, back in 1951, will confirm that this is the first time in all those years that I've asked for a birthday present. Well, I'm 75 and it's about time you got me something.

What I want is a bigger magazine. You'll benefit too because that'll give me more pages to publish articles. I think we have enough regular columns now, and most of you will agree that my editorials are already longer than they ought to be, so a bigger magazine will mean more construction articles and equipment reviews. How can you give me a bigger magazine? That's simple — all you have to do is convince one ham friend of yours to subscribe to *73*. If every reader would get one extra subscriber I believe we would soon have double the number of ads, and that would allow me to double the number of pages in the magazine.

I was just looking at a 1980 issue and it had 274 pages. That's three times our present size. I'll bet we could match that if we had double our current subscriber base.

No, Wayne doesn't get rich if we have more readers. I retired a few years ago and stopped drawing any salary, so any added revenues will go right into making the magazine bigger and better.

Please wish me a happy 75th birthday with a nice present.

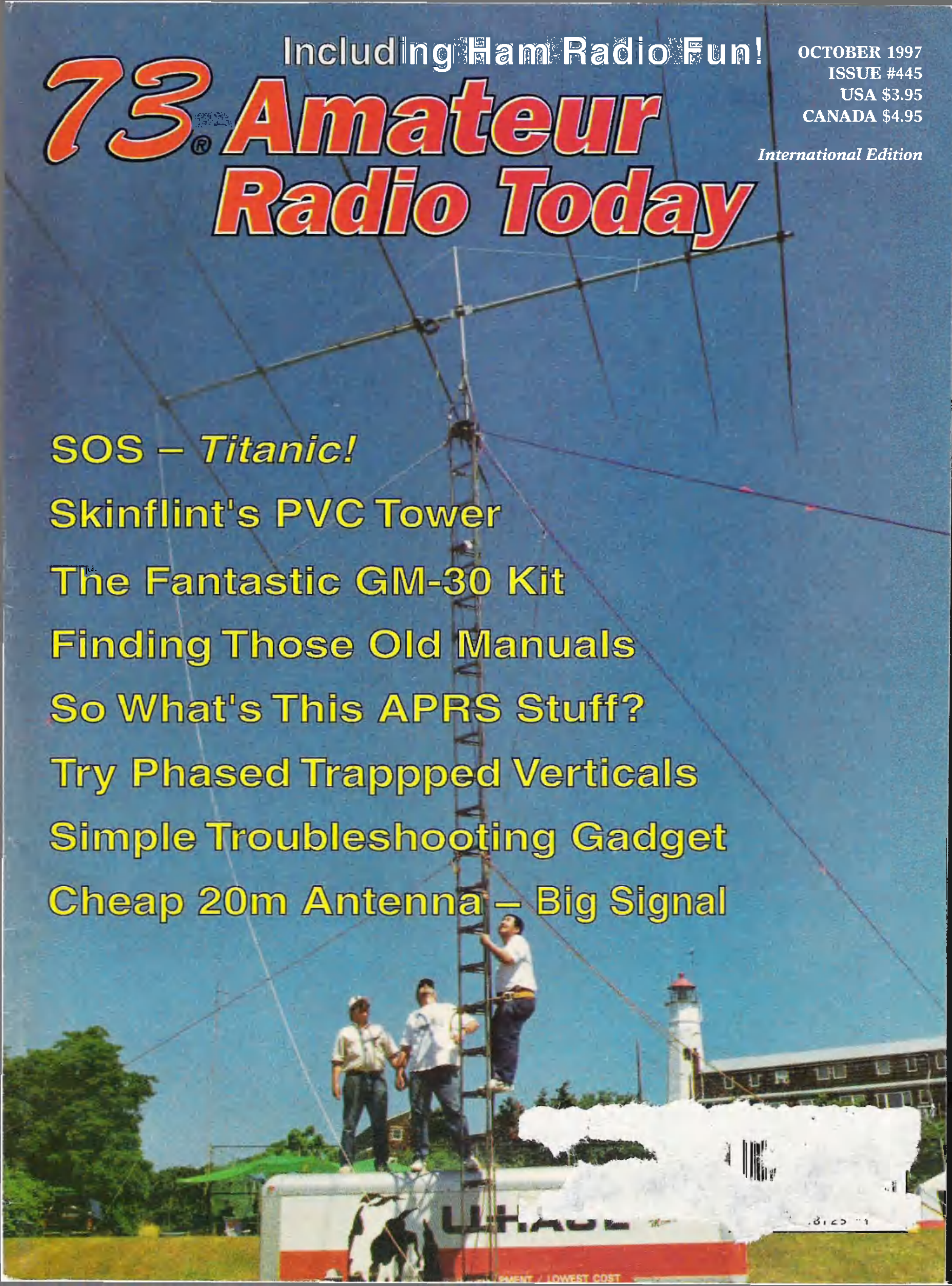


Including Ham Radio Fun!

73 Amateur Radio Today

OCTOBER 1997
ISSUE #445
USA $3.95
CANADA $4.95

International Edition



SOS – *Titanic!*

Skinflint's PVC Tower

The Fantastic GM-30 Kit

Finding Those Old Manuals

So What's This APRS Stuff?

Try Phased Trappped Verticals

Simple Troubleshooting Gadget

Cheap 20m Antenna – Big Signal

THE TEAM

El Supremo & Founder
Wayne Green W2NSD/1

Associate Publisher
F. I. Marion

Associate Technical Editor
Larry Antonuk WB9RRT

Nitty Gritty Stuff
J. Clayton Burnett
Priscilla Gauvin
Joyce Sawtelle

Contributing Culprits
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Jack Heller KB7NO
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister W5ACM
Dave Miller NZ9E
Joe Moell KØOV
Steve Nowak KE8YN/5
Carole Perry WB2MGP

Advertising Sales
Frances Hyvarinen
Roger Smith
603-924-0058
800-274-7373
Fax: 603-924-8613

Circulation
Linda Coughlan

Data Entry & Other Stuff
Christine Aubert
Norman Marion

Business Office
Editorial - Advertising - Circulation
Feedback - Product Reviews
73 Amateur Radio Today Magazine
70 Route 202N
Peterborough NH 03458-1107
603-924-0058
Fax: 603-924-8613

Reprints: $3 per article
Back issues: $5 each

Printed in the USA by
Quad Graphics

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made after publication. Please submit both a disk and a hard copy of your article [IBM (ok) or Mac (preferred) formats], carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

73® Amateur Radio Today

Including Ham Radio Fun!

OCTOBER 1997
ISSUE #445

TABLE OF CONTENTS

FEATURES

REVIEW

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: Don Halmy KB2PVT, John Milligan N2NPU, and George Sau WB2ZTH check out the six-element tribander used at WB2QBP, club station of the American Red Cross Emergency Communications Service. Field Day 1997 photo taken at Eaton's Neck Coast Guard Station, Northport, LI, NY, by George Pataki WB2AQC. Next month: *73* greets November with one of its all-time greatest cover shots, sent in by ... *you*?

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $33.37, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface. $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Addiction

Quiz: What's the most addictive drug? Is it heroin, cocaine, crack, opium, or nicotine? You probably saw that one coming and picked little ol' nicotine. Right. Research reports tell us it is four and a half times as addictive as the next in the list. The heroin- and cocaine-addicted can go cold turkey and be through with the withdrawal symptoms in a week to 10 days. Smokers can suffer for up to two years. No wonder the recidivism rate is so high!

With stopping so extremely difficult, and with the tobacco companies well aware of this, their efforts have been centered on getting the youngsters started. And they get a whole lot of help from parents who, as role models, are smoking.

I was fortunate in one respect. My father not only beat the hell out of me when he got angry, but he also was unable to communicate. We never were able to talk or share any father-son experiences. His nightly battles with my mother, whom he'd knock down when he was drunk, which was a good deal of the time, further estranged us. In addition to smoking several packs of Camels a day, he also drank constantly.

The fortunate part was that this generated a highly negative interest in my being like him, so I didn't smoke or drink, even when my fraternity brothers at college were having beer busts, drinking until they puked and then drinking more. My dad loved fishing, so I still have no interest in it. Oh, I did enjoy spear fishing, but that was like hunting, only in three dimensions. These days I do my hunting with cameras, above and below the water.

My dad was a pioneer aviator, so it wasn't until I was around 35 that I started flying and bought a plane.

So you have a choice in training your children: Either provide a good positive role model or, if you are a smoker, you can use my father's approach and be such a bastard that your kids will avoid doing anything you enjoy. Your choice.

Why Doctors Are So Bad

It's logical, if you'd ever stopped to think about it. Let me put this in simple terms. Back in 1963 the ARRL, in a move which they expected to be controversial, and thus get hams talking about the League and joining, proposed to the FCC that around 90% of the hams have to take a new license test in order to continue to use phone on the HF bands. They called this beaut Incentive Licensing. The unintended result was that at least 50,000 hams went ballistic, squealing like ... er ... stuck pigs, saying they weren't about to memorize a whole big bunch of damned questions and answers again to be able to keep talking. They were really mad. So, being convinced that the ARRL would get their petition passed into law, they put their rigs up for sale for whatever they could get for them ... which was often about 10¢ on the dollar.

This resulted in three things. One, the 11% per year growth the hobby had had for the previous 17 years stopped dead, with a huge net loss of licensees over the next few years. Second, most of the ham clubs around the country blew away ... particularly the school radio clubs which had been providing us with new young hams. Indeed 80% of our new hams had been teenagers. Third, it put almost 90% of the ham stores out of business in one year, since the sale of new equipment totally stopped. And three-A, this, in turn, put virtually all our American ham manufacturers out of business, and our American ham industry has never recovered. It was a mess, and all because tens of thousands of hams panicked over being re-examined. The FCC fiddled around with this hot potato for five years and finally cut the baby in half, taking away half of the phone bands from the Generals instead of all, as requested by the ARRL.

Let me put this another way. If you're a college graduate, how'd you like to be called in to retake your final exams in every course you passed several years ago? You'd find that you've forgotten around 90-100% of everything you once "knew." Well, it's the same with doctors. They have forgotten at least 90% of what they "learned" in medical school. Worse, few of them have the time to read the medical journals, so they don't even know what's going on that's new. They get almost all of their new information from "detail men," the salesmen for the pharmaceutical companies. And their whole purpose in life is to get the doctors to use their company's patented drugs.

Doctors are taught virtually nothing in medical school about how to keep people healthy, only what drug, knife or Band-Aid™ to use when certain symptoms show up. They know almost nothing of eliminating the causes of illness, just what to do to patch up the resulting problems.

Yes, this is a repeat of stuff I've been writing over and over. Well, I'm going to keep hammering until I get you over your blind trust in institutions and start thinking for yourself. We're in the middle of an unholy mess, all caused by you and your parents going to sleep at the switch. Our medical industry is a mess, as are our schools, courts, Congress, and so on down the line. The AMA, NEA, FDA, NIH, and all the rest of the alphabet are as crooked as hell, serving themselves, not the public they're supposed to help.

Those Darned Fluorides Again

Just in case you are still, despite my warnings, drinking water laced with fluorides or using fluoride-laced toothpaste, or even allowing your dentist to put fluoride on your or your children's teeth, maybe you'd better find out the real story.

Yes, in this best of all countries in the best of all times, your meats are laced with hormones, plus salmonella in your chicken. Your water has government-added fluorides and chlorine, plus God knows what else, such as dioxin, which has seeped into our country's aquifers. The air in your cities is poisoning your lungs.

Under pressure from the fluoride suppliers, our cities have added this carcinogen to your drinking water. The excuse is that it is supposed to help children's teeth. A study of 480,000 children showed that it doubled their tooth decay. Researchers have estimated the fluorides in our water are causing about 60,000 people to die of cancer every year that otherwise wouldn't.

Recently the EPA and National Research Council (NRC) okayed 4 ppm of fluoride in our drinking water, despite the evidence from double blind studies that even 1 ppm causes severe allergic reactions and destroys immune cells. If you do some homework you'll find that the EPA has gone to extremes to hide the facts of fluoridation from the public. It's a fascinating, but not particularly surprising, story of corruption.

Change

While resting for a few minutes after a very brisk walk down the dirt road that goes past our farm, watching the ever-changing display of wildflowers along the road and in our fields, I got to thinking about change. Even if I remembered everything I was "taught" in college, virtually all of it is meaningless in today's world. The stuff we had to commit to short-term memory for the endless quizzes is all out of date. The old economic theories have been shown

to be in error. Ditto what we were taught in psychology, physics, and so on. Quantum theory was never even mentioned. The atom was, then, the smallest particle. The Earth had been formed when another star passed close to the sun and sucked material off which condensed into the planets. The concept of plate tectonics was crazy.

The problem with all this is that change is accelerating. It no longer takes 50 years for what you commit to short-term memory in college to become obsolete. The downside of this is what we call the establishment, which can't deal with change, so they fight it every inch of the way. People tend to form bureaucracies as a way to fight change. Bureaucracies are comfortable for the worker bees — the drones — and holy hell for leaders. Alas, we don't know why some people are born leaders and others are born followers (a.k.a. sheep). Fortunately for society there are very few leaders and an abundance of followers.

Leaders tend to become entrepreneurs, preferring not to have to take orders from others. And leaders tend to welcome change and take advantage of it, which may explain why so few successful entrepreneurs bother to finish college … if they even go. Until college gets re-invented it's a bummer for leader-type people, but a benefit to the followers who want to work in a bureaucracy, and bureaucracies just love credentials. They help establish pecking order.

Leaders seem to be born, not made. And it has nothing to do with intelligence. I know hundreds of Mensa members and the Mensa groups are just as hard up for leaders as any other group. Like your ham club, for instance.

Bureaucracies have a couple of serious problems. First, they tend to be rigid. They're able to deal with a fixed set of situations (the rule book), but if some factor changes, they're very slow to respond. Like never, if possible. Secondly, the norm is for promotion to work from the bottom up, depending more on seniority than skills. The fastest way to be blackballed and never be promoted is to be creative and try to change things. The end result of this is that the top management is made up of workers who have never had a creative idea and who have spent their working lives protecting the status quo … resisting change.

And the same rules apply to our military, which is a humongous bureaucracy. Congress made Rickover an Admiral, not the Navy. He pushed for nuclear-powered ships, which the Navy brass fought against bitterly. Just as the Army fought air power a generation before, with the famous court martial of Captain Billy Mitchell, who did his best to initiate change. So they wanted to put him in prison to shut him up. My dad, by the way, knew Mitchell and was stationed at Langley Field with him at the time of the court martial.

Don't make waves is the rule for workers. CW forever, right?

Can 200 Million Americans Be Wrong?

You bet your sweet bippy they can! A recent poll reported in *USA Today* said that 80% of Americans believe that the government is hiding information on alien contacts. Well, I agree with the 80%, but my problem is that about 79% of the people believe this for the wrong reasons. I doubt that 0.01% of the public has done much homework on the subject. There are some excellent books available, and a ton of trash.

Well, that's one of the big problems with the Internet. There's a lot of valuable information available on it, but these gems are so buried in garbage that they're almost impossible to find. Are there any garbage sifter volunteers out there?

I'm doing my share of the grunt work, reading books highly recommended by the *73* readers (and Art Bell listeners), sifting for gems. I've found about a hundred really important books so far and they're reviewed in my guide.

Our beloved government is involved in keeping secrets on so many levels that it's no wonder there are so many conspiracy theories flying around. With at least 22 known government intelligence (?) agencies, all with seemingly unlimited black budgets, and all seeming to be busy keeping secrets from us, it's easy for the unwary to buy into almost any weird theory.

The only conspiracy I personally know about is the Amelia Earhart one, and the government is still keeping the lid on that after 60 years. There should be some sort of sundown law on secrets. Isn't it about time for the Navy to admit that, yes, Amelia was on a spy mission for them when she got lost. And that she was captured by the Japanese and executed as a spy. Case closed.

Now, about those pesky aliens. As I've opined before, there is a lot of credible evidence that the critters are not only here, but have been here for a long, long time. Perhaps thousands of years. There's also evidence that there are a couple dozen different species involved. And since their technology is at least thousands of years ahead of ours, there is no good reason for their coming out of their closets.

Hey, I can cook up conspiracy theories too. Could Laurence Rockefeller and the Rothschilds be alien entities? They are the small group that has gained and kept control of the world's money supply. Well, that concept might help bring the New World Order and the alien invader conspiracy groups together. And it makes sense. Once we know that ETs are here it's only logical for them to set up a secret system which would give them control over us. And this is one that's been going on for a couple of hundred years or more.

Murdering Millions

We're all well aware of the five million Jews Hitler and company erased. And we've heard about Stalin doing a number on his people, plus Pol Pot in Cambodia, Mao in China, and the Hutus in Rwanda, etc.

A recently remaindered 1993 book by Zbigniew Brzezinski (*Out of Control*) fleshed out the numbers for me. We're now finishing up the bloodiest century in history, by a wide margin. The two world wars consumed 8,500,000 and 19,000,000 military lives, respectively. Other wars added another 6,000,000 plus to the total, plus another 13,000,000 civilian lives lost in WWI and about 20,000,000 in WWII. Then there were about 15,000,000 deaths in the Sino-Japanese war. And another 6,000,000

Continued on page 40

LETTERS

From the Ham Shack

Laird Wilcox KBØRDL. I have been a licensed ham for a little over two years now although I've followed the hobby for some years. I really enjoy the friends I have made with my two-meter HT and mobile and I have joined three clubs in the Kansas City area. I have chosen to remain a no-code technician because I have found the Internet to be a more reliable and useful method of long-distance communication. I am a writer by profession and one of my many correspondents is in Stockholm, Sweden, and another is in Barrow, Alaska. I can communicate with them easily and almost instantaneously with my computer, which requires no license and no Morse code proficiency. We can send a volume of information back and forth with the Internet that would be impossible with HF radio under the best of circumstances. Most of the other new hams I know feel the same way and are not interested in "upgrading" for reasons I will explain.

What I have found most fascinating about amateur radio, however, is not the theory or application of wireless communication, but the fact that a single organization has an iron-fisted grip on its future. I am, of course, referring to the ARRL. Even this would not be alarming if it were more in touch with the modern world. But such is not the case. My general sense is that the ARRL is primarily interested in keeping ham radio as it has always been, rather than taking into account new technologies such as cellular phones and the Internet, both of which do much of what ham radio does — without the expense, difficult examinations or requiring a proficiency in an increasingly irrelevant 19th century art: Morse code.

The simple fact is that new hams — and without new hams amateur radio is doomed to extinction within a generation — find themselves burdened by examinations that assume one needs to be proficient in radio construction in order to operate VHF radios that are less complicated than their stereos. To use an analogy, if one needed a similar level of proficiency to operate an automobile one would need to know all about metallurgy, the theory of the internal combustion engine, the hydrodynamics of transmission fluid and the chemistry of emission controls just for starters. Obviously, one should know enough radio theory to avoid interfering with others and to obey the FCC rules, but I have spoken to Extra Class hams who have never had any practical need for 75% of what they had to memorize in order to get licensed, and who have never used Morse code except to pass the test. They bought their radios off the shelf, installed their antennas according to the instructions, and were in business.

Photo A. Athens, Greece, Hamfest '97.

The argument goes that if we lighten the burden of entrance to the hobby then it will become "just like CB" or "any idiot could become a ham." Well, I've listened to 40 meters and at times it's worse than CB. By no means have we kept the idiots out.

As for the Morse code, by the end of this century most countries will probably drop it as a requirement for licensing hams. Fewer and fewer emergency services even monitor it and those extremely rare instances where it may possibly be useful hardly justify requiring it for licensing. Both advances in radios and the prevalence of communication satellites have dramatically lessened the usefulness of CW. We might as well require proficiency in Flemish or Tagalog on the assumption that we might possibly have to assist somebody from Belgium or the Philippines in an emergency.

One of the uses I've found for VHF radio is to function as a trained storm spotter for the county Emergency Preparedness office. What I think is beginning to dawn on people, however, is that improvements in weather radar and other developments in forecasting are lessening the need for large numbers of spotters, and that cellular telephones would suffice in most instances.

The simple fact is that cellular telephones have made one of the primary justifications for amateur radio — emergency communications — increasingly irrelevant. At our recent Field Day I watched as ham operators contacted people in Germany and Australia, in some cases using Morse code, and I had to wonder how useful that would be in case of a tornado or other natural disaster here, or even over there. Don't get me wrong — everybody had a good time, including myself. I think it's a good way for hams to get together and have fun. It reminded me a lot of Boy Scouts toiling away to get merit badges while enjoying hot dogs and soft drinks. As for keeping the hobby the exclusive province of an elite select few with the various "gatekeeper" requirements, this runs counter to modern social trends whether we like it or not. I'll have to admit that I feel a little pride at having passed a difficult test in order to use my VHF radio, but this is offset by the knowledge that much of the test I had to pass was unnecessary to make me a responsible radio operator. Why do I need to know what a microfarad is? However, I can think of one "gatekeeper" requirement that makes sense and that is charging a significant fee for a license — say $50 per year. If this were done, then perhaps the FCC could actually afford to police amateur radio operators who misbehave and the hobby would have a little financial clout when it comes to keeping its frequencies.

If all this sounds heretical and revolutionary, that's too bad. In a way, I wish some of these facts weren't true myself. I would agree with those who say the pace of change is disorienting and worrisome at times. At 54, I'm certainly among those with a taste for nostalgia, but reality is reality and I think it's time the oligarchy that runs amateur radio pulls its head out of the sand and faces that reality whether they like it or not.

OK, Laird, by golly, you've convinced me. When are you going to start getting petitions signed to get the FCC to bring the amateur radio exams into the latter 20th century? ... Wayne.

Nicolas Cassimis SVØCY/KD2IR. After relocating in Greece, the one thing that I missed the most was the US ham flea markets. Visiting a hamfest was the best way to spend a weekend to get together with old friends and bring home some bargains. The Athens Hamfest was born in 1993 and has become an activity that most Greek and European radio amateurs look forward to every year. It is not a Dayton, but it is certainly a ham activity that has everything. It takes place once a year in the end of May at Papagou, only five miles from Athens. In 1993 the turnout was poor, but now amateur groups from all over Greece visit the hamfest every year. This year, with more than 50 sellers, the buyers had a ball! Greece is not only a paradise in archaeological sites, but in electronic antiques also. For many years the high cost of amateur equipment forced Greek amateurs to home-brew their own equipment. Now only a few amateurs construct their own transceivers. I saw some wonderful bargains in antique radios this year, and picked up a couple beauts for peanuts. So, what are your plans for next May? A trip

to Greece will add some extra pounds—the moussaka and souvlaki are delicious—and you might bring back to the States a good antique souvenir at a bargain price.

David Kemmer, Oronoco MN. Another great editorial ... DON'T let them talk you into exclusively writing about amateur radio. I, for one, buy the magazine because of your editorials and not because of ham radio. I have a music, piano, and electronics background and could easily be a ham enthusiast, but I won't allow it because of the time constraint. The reason for writing is your mentioning the transmutation of the elements. I have seen a video and read about an experiment with a flock of hens that were carefully fed a diet totally lacking in calcium and rich in potassium. Potassium [#19] is one number below calcium [#20] on the periodic table of the elements and quite different from calcium. The hens continued on their merry egg-laying way, producing full-strength egg shells that were rich in calcium with no evidence of surplus potassium in spite of the diet. The experiment went on for months ... to the point that the hens should have ended up with weakened bones if they were robbing their body calcium to continue to produce eggs. There was no evidence of depletion of body calcium. Therefore the only logical deduction was that the hens were transmuting potassium [#19] "up" one number to calcium [#20]! And they were doing all this chemistry without a college degree! Keep writing those editorials!

Skeptics have obviously not read either The Secret Life of Plants *by Bird & Tompkins — which is in my guide to books you should read — or Louis Kervran's* Biological Transmutation, *which probably should be listed in my guide. Kervran did some outstanding work in this field, even with men, showing that many or all living things are constantly transmuting elements as they are needed. For more information on elemental transmutation read Michio Kushi's* The Philosopher's Stone *— which is in my guide — and René's* The Last Skeptic of Science. *My message for skeptics is simple: For heaven's sake, do your homework. I do. ... Wayne.*

Alfred Pedneau K5HKG. Wayne, what do you think about the conspiracy with the large oil companies and the automobile/truck companies? Do not see why you haven't written something about this in your magazine a long time ago. One of my sons has a '97 Dodge Dakota with a V8 engine. This truck averaged only 17-1/2 miles a gallon on a drive up to Yellowstone National Park from here in central Louisiana. You know something is wrong if the scientists and engineers we have here in the USA can send a man to the moon, build and use the Hubble Telescope and send a probe to Mars. Why then can't these same people develop an engine that is much more fuel efficient? I have always said the large oil companies have paid off lots of people who have developed much more efficient engines. I know there are engines out there now that could be installed in our vehicles which would save the general public millions of dollars a day. If we use less fuel then we would not have to import as much oil as we do now. We are sending millions of our hard-earned dollars every day to those sheiks who already have more money than they know how to spend.

Alfred, OK, let's say you're right about the conspiracy. Step 2: What can be done about it? You didn't go to Step 2. But I have. Fighting multi-billion dollar industries on their turf is grade-A stupid. The public is asleep — ballgames, beer, sitcoms — and doesn't want to be bothered, so why tilt at windmills? My approach has been to find an alternative to gasoline and promote that. The alternative that holds the most promise is cold fusion, which has been proven to work. It is non-polluting, will cost about a tenth as much as gas or oil, will not deplete our natural resources, and will put the oil, coal and natural gas companies out of business, as well as the electric power generating and distributing companies — which largely use oil and coal. How's that for an end run around the conspiracy? How much do you know about cold fusion? Stop bitchin' and start pitchin'. For $5 — plus $3 s/h — I'll send you #22, the latest issue of Cold Fusion, *which has the complete Patterson patent, the NASA lab report confirming the cold fusion generation of excess heat, and a theory article explaining exactly the physics of cold fusion. ... Wayne.*

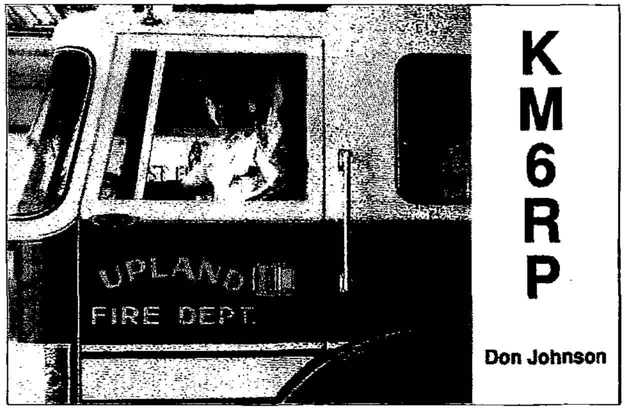


Photo B. *Don Johnson KM6RP sent news of his club's Field Day.*

To Don Johnson KM6RP: *Many thanks for sending the two-page big 10-4 ham article from the* Inland Valley Daily Bulletin. *To the rest of you: So where was* your *club PR officer on Field Day? ... Wayne.*

Frank Wright VK4SE. I enjoy reading your editorials in *73 Magazine* and look forward to my copy each month. I am also very interested in the bioelectrifier and silver colloid generators. I have made several of them and they all work like a charm. My doctor has two patients suffering with AIDS and I have got him interested in doing

Continued on page 18

QRX . . .

Young Ham of the Year

Brian Mileshosky N5ZGT, of Albuquerque, New Mexico, has been chosen as the1997 "Young Ham of the Year." Brian is the son of Janet and Patrick Mileshosky, and is attending the University of New Mexico's School of Engineering with career aspirations of possibly joining the Astronaut Corps.

Brian was nominated by Jay Miller WA5WHN, who has known Mileshosky since he was first licensed. Miller calls Brian: "... a truly dedicated young adult who uses his amateur radio hobby as a service to benefit his fellow man."

Joe T. Knight W5PDY, the ARRL Section Manager for New Mexico, wrote to the selection committee that he had had an opportunity to know and observe Brian "... in his enthusiastic quest for knowledge and learning in the varied areas of amateur radio, engineering and science ... and his support of youth all over the state of New Mexico." He further related that Brian has "... been involved in many search and rescue missions, as well as public service events. He has also established a packet radio user's group, and controls a packet relay station which he maintains 24 hours a day."

As a General Class licensee, first licensed at the age of 12, Brian is active on all bands and modes with the exception of SSTV, satellites, and microwave. He has a particular affinity for QRP, and has been part of record-setting long-distance QSOs. As *Worldradio Magazine's* Youth Columnist, Brian has encouraged other young people to find their own place in the hobby, and has served as "Elmer" to many younger boys and girls.

The Boy Scouts of America has played a large part in Brian's life. He is an Eagle Scout, and a member of the Order of the Arrow. In addition to serving as Post President, he was Senior Patrol Leader in the 1997 National Jamboree Troop.

In addition to scouting and amateur radio, Brian does have time for other interests. Astronomy is one of them. His high school's science club is another. There he participated in the construction of a deep-space radio telescope.

There is also varsity track and field, and we can't forget his 40-plus in-service hours working for Habitat for Humanity. The list of accomplishments for this young man is a long and distinguished one.

Annual presentation of the *Newsline* Young Ham of the Year Award is made at the Huntsville Hamfest Banquet, in Huntsville, Alabama. The presentation of the award as a regular feature of this prestigious amateur radio convention has been made possible through the generosity and kindness of the Huntsville Hamfest Planning Committee and its chairman, Scotty Neustadter W4WW.

The *Newsline* Young Ham of the Year award program (formerly the *Westlink Report* Young Ham of the Year), now entering its 13th consecutive year, is presented annually to a licensed radio amateur who is 18 years of age or younger and has provided outstanding service to the nation, his community or the betterment of the state of the art in communications through amateur radio.

Past recipients of the Young Ham award include Shawn Alan Wakefield WK5P, of Bartlesville, Oklahoma (1986); David Rosenman KA9PMK, of Muncie, Indiana (1987); Jonathan Binstock NK3D, of Potomac, Maryland (1988); Erin McGinnis KAØWTE, of Topeka, Kansas (1989); Mary Alestra KB2IGG, of Staten Island, New York (1990); Richard S. "Sammy" Garrett AAØCR, of St. Louis, Missouri (1991); Angela (Angie) Fischer KBØHXY, also of St. Louis (1992); Kevin Boudreaux N5XMH of New Orleans, Louisiana (1993); Allison Daneen Zettwoch KD4CKP of Louisville, Kentucky (1994); Adam Weyhaupt N9MEZ of Alton, Illinois (1995); and Toby Metz KB7UIM of Boise, Idaho (1996).

TNX Bill Pasternak WA6ITF.

Wind-powered station adds a nostalgic touch to Field Day in Cedar Rapids.

Not Just Hot Air

A neat 1938 Wincharger was employed to operate a two-meter simplex station at the Cedar Valley ARC Field Day event. Contacts were made from the Kirkwood Community College FD site, Cedar Rapids, Iowa, to Minnesota, 100+ miles away, with 10 W on FM. Amateur Radio Explorer Post 1085 helped out.

TNX for the photo to Jim Covington AAØXJ.

Pet Hams: Care and Feeding

Pet hams are so intelligent that they often seem human, but they can be difficult to raise. Only someone with great patience should attempt it. In case you do decide to take the risk, here is a short guide to the basics.

Living Area: A pet ham needs a private nesting area—an entire room where it will not be disturbed. Your pet ham will spend many happy hours alone there with its treasures—boxes, wires, bits of metal, glass, plastic, paper, etc., that it will bring home after it ventures out. You will want to encourage your pet ham to confine its activity to this room, to prevent the entire house's being subjected to noise, clutter and boring of holes in the walls.

Expenses: Keeping a pet ham is expensive, but unlike most pets, a pet ham can be trained to work outside the home for a few hours each day. It may even bring in enough money to offset its expenses.

Feeding: A well-behaved pet ham will eat with the family occasionally, but it will usually feel more comfortable and secure taking its meals in the nest room. You must be sure that your pet ham is well supplied with food and drink during the long periods it spends alone in there, even if it does not beg or whine.

Housekeeping: Most pet hams can be trained to use the family toilet facilities, but a few require a toilet or portapotty in the nest room.

Obedience Training: A pet ham can be trained to perform simple tricks, the most common being *sit* and *speak.* Do not be alarmed if it practices them for hours at a time in its nest room.

Health Problems: The pet ham typically suffers lower back pain and minor throat irritations from too much sitting and speaking, but health maintenance costs tend to be minimal.

Travel: Your pet ham will happily travel in the family car or even by air if allowed to bring along certain familiar items from the nest room. Most pet hams enjoy trips to places where they meet pet hams from other families.

Breeding: If you plan to breed your pet ham, you should do so as soon as possible after you get it. As a pet ham matures, it becomes more increasingly reluctant to engage in activities not associated with its nest room collection.

Behavior: If you plan to disturb or try to talk to your pet ham while he is talking, be prepared to be snapped and growled at, especially if he is in the contest mode.

Lifted freehandedly from the July 1997 edition of *The Repeater*, newsletter of the Alamo Area Radio Organization, who acknowleged that *they* had borrowed it from somebody else's newsletter.

Ten Tips for More Effective Public Service

1. Make sure your radio is in top operating condition. Small problems (such as loose antenna connections, bad microphones, intermittent operation, etc.) may be just annoying in casual operation, but will cause major grief under the continuous/server service of net/emergency operations. *Hint: Listen to someone else using your radio to hear how it sounds! I hear lots of people with crummy signals and almost no one comments on them. Be a friend, tell the other person that they have a noise/hum/buzz/rattle. Offer to let them use your rig while you use theirs—and get about a mile apart for the test.*

2. Don't operate your HT with it hanging from your belt. Using the radio while it's strapped to your waist reduces your effective radiated power by more than 10 dB. That's a 90% reduction in power! Hold your radio in your hand, with the antenna in the clear. *Hint: You can buy speaker mikes that also have antenna jacks on them. This*

allows you to have the radio on your belt, but keeps the antenna in the air.

3. Regarding antennas, those three-inch rubber "dummy loads" may be cute, but you're throwing away 3 to 6 dB of power when using one. A telescoping half-wave antenna has gain as much as a 10 dB improvement over the three-inch ones. One dB can mean the difference in whether a message gets through. *Hint: Telescoping or long dual-band rubber duckies are fairly cheap, and really help when you are away from the repeater.*

4. Have charged batteries and spare battery packs! If you have a dry cell battery case make sure you have plenty of alkaline or recently-charged batteries to put in the case. Buying a spare pack makes lots of sense, while one is charging, you can be talking on the other one. *Hint: Take a look at NiCd or metal nickel hydride battery packs as an alternative.*

5. External microphones/headphones. In noisy environments such as parades, runs, and special events, putting on some "walkman"-type headphones will enable you to hear your radio (after all, you are there to communicate). A speaker mike is handy, but tends to amplify the ambient noise. *Hint: the Heil headset/microphone combos are great at noise reduction and are focused on the human speech range of audio frequencies.*

6. Speak slowly and clearly when transmitting. Net control has to sort out all manner of voices. Speaking too fast or mumbling just serves to confuse, can cause messages to be repeated multiple times, and adds no value. *Hint: When calling net control, be sure that you key down for a half-second and talk slowly and clearly.*

7. Check your ability to use simplex. Most of us have the local repeaters programmed but sometimes we use simplex for events, or for secondary nets. *Hint: Be familiar with your rig(s) and know how to program in simplex and/or repeaters with PL tones.*

8. Listen to net control. Be sure to direct all communication through net control. Identify your station when calling net control and keep all communications direct and to the point. *Hint: Net control needs to instruct the net members as to what net control wants to hear (medical emergencies, first/last runner, etc.) AND the net members need to pay attention.*

9. If you MUST leave the radio or your assigned area, seek permission. You are there to provide communications, so don't just walk away. Let net control know you are leaving and when you plan to return. *Hint: Bring a backpack with drinks, some munchies, a cap, and a small towel, along with spare batteries, etc.*

10. Project a good image to the non-hams around you. When you are using amateur radio in public you represent Amateur Radio as a whole. *Hint: If you have the time (free from duties), explain what's going on, and how to become a ham.*

From the *ARRL Field Forum*, reprinted—with KA5GLX's hints—in CLARC's *Radio Amateur Gazette* (TX), April 1997. 73

Surface Mount Devices

Everything you didn't want to—but should—know.

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

Anyone opening a recently-built piece of electronic equipment will notice the very small parts. In most cases, they are mounted on both sides of the printed circuit board. The process for assembling boards using these small parts is called *surface mount technology* (SMT) and the devices used are *surface mount devices* (SMD). **Fig. 1** shows the shapes of three typical SMDs.

Although specialized assembly equipment has been developed for placing and soldering SMDs in high-speed industrial operations, ham experimenters can take advantage of the small parts using a manual assembly process. There are a number of SMD project kits and individual parts being made available for hams, encouraging project construction. Though the assembly process is slightly different from (and more tedious than) conventional through-hole parts, it is within the capability of most experimenters. The manual assembly will result in the same reliability as the industrial process.

With the availability of inexpensive SMDs, it is desirable to use as many of them as possible in ham projects, even though it may be necessary to mix SMDs with through-hole parts to achieve a desired circuit function. The circuit function remains the same, regardless of the part size. However, the smaller physical profile of the SMD lends itself to VHF and UHF operations.

A few specialized tools aid the manual assembly process, but a steady hand is most valuable. Aside from that, the most important tools for a manual assembly process are: PC board holding fixture; sharp, sturdy tweezers; a soldering iron with a tip diameter in the range of 0.012–0.015 inch; 0.015-inch-diameter rosin-core solder; liquid rosin soldering flux; and a large lighted magnifying glass.

Get a soldering iron capable of 25–37 watts, providing a tip heat range between 650 and 750 degrees Fahrenheit. Because components are very sensitive to *electrostatic damage* (ESD), it is a good idea to equip the assembly station with a wrist strap tied to the iron and circuit board being assembled—cheap insurance against the loss of a part during an assembly/rework process.

The *caveat* to the manual assembly process is in the removing of a misplaced or defective part. In most cases a few SMD parts can be saved, but many will be destroyed during removal.

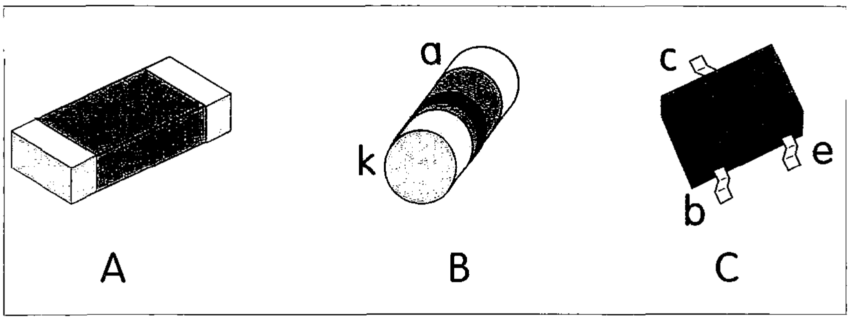


Fig. 1. Typical surface mount components: (A) resistor and capacitor; (B) round diode; (C) SOT 23 transistor.

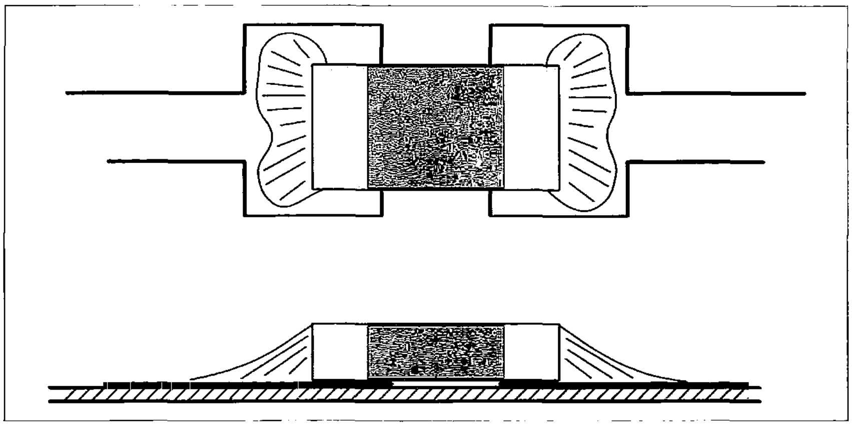


Fig. 2. Correct solder wetting between the pad and SMD.

Therefore, it is vital to verify the part and placement *before* soldering.

Soldering

There are only a few simple steps:

1a. On a board with untinned solder pads, clean the pads, add soldering flux, and tin using a minimum amount of solder.

1b. On a board with tinned pads, add a small amount of solder to only one pad for the part to be mounted.

2. Verify the part to be placed and its orientation. Double-check before soldering.

3. Place the part and hold it in place with tweezers. Again, verify the position.

4. Touch the iron tip to the solder and carry a small amount to the SMD component lead over the solder pad. As the solder melts, the SMD may move toward the board. Be sure it's positioned exactly where you want it before removing the iron.

5. With the tweezers, press the part against the board while soldering a pin on the opposite side of the SMD.

6. Solder each additional pin by heating the joint and adding a small amount of solder. The tip and solder must touch only one pin at a time, to prevent solder bridging.

7. Inspect each solder joint.

8. Place the next part and repeat steps 2 through 7 until all parts are mounted.

Cleaning

Following assembly, the circuit board must be cleaned thoroughly with denatured alcohol to remove all traces of flux. It is best to clean the flux while it is soft, following each component mounting.

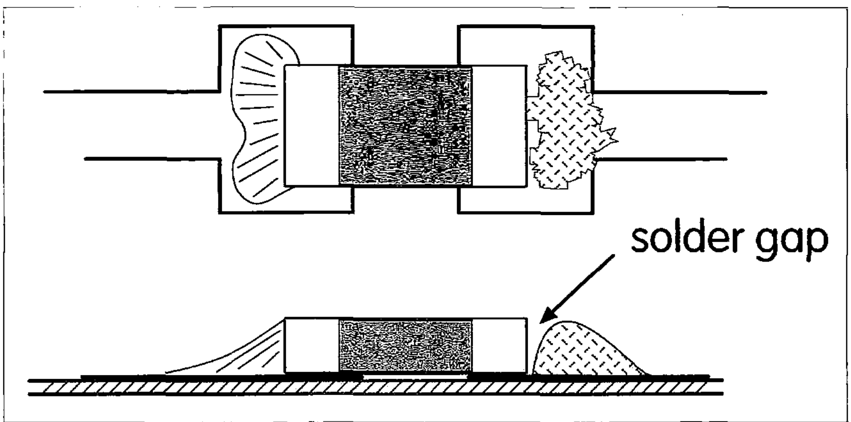


Fig. 3. Absence of a solder joint. There is no solder wetting of the SMD. The lack of wetting may also occur at the pad to create an open or intermittent connection.

Although post-heated rosin flux is considered to be inert, leakage paths do develop over time and may cause problems, particularly in VHF and UHF circuits. Therefore, remove as much of the flux as possible. The techniques for removing flux vary with each project, but typically, a stiff horsehair brush and lots of alcohol are what it takes. If possible, the board should be immersed in the alcohol, but very vulnerable components should just be washed with large amounts of alcohol.

One of the tests for sufficient board cleaning is to wash the board and allow it to dry in a vertical position. If flux streaks appear, clean the board again, and repeat as many times as necessary. Use fresh alcohol for each cleaning to prevent re-contamination.

Component removal

Surface mount devices may be removed and salvaged from circuit boards manually, but there is a risk of losing the part and/or damaging the pads. The process is tedious and difficult so be careful. Again, a wrist strap tied to both the board and iron will reduce the possibility of electrostatic damage.

Here are some handy tips for removing SMDs:

- Use Solder Wick™ to remove as much solder as possible from each SMD terminal. In some cases it may help to add a small amount of liquid flux to the solder joint.

- Use a damp sponge to keep the iron tip clean.

- Use a pointed-tip instrument, such as an X-Acto™ knife. Slip the edge of the knife under a lead and apply heat, allowing the lead to lift slightly. Remove more solder, if necessary, to free the lead.

- Move to each lead consecutively until all are free and the part is removed. Ceramic and glass SMDs use plated-on terminals. During a solder removal operation, the terminal plating may be removed, destroying the part. If the part must be salvaged, the use of silver-bearing solder instead of tin-lead will reduce the loss of plating, during both assembly and part removal. To remove, flow the heat with silver-bearing

solder to both terminals (of a two-terminal device) and "float" the part off the pads. If another part is to be mounted on the same pads, clean up the pads with Solder Wick and follow the steps indicated in the soldering process.

As an alternative removal process for a known defective component, cut each lead close to the part body and remove the part body. Grasp each lead with tweezers, then heat and remove the lead. Use Solder Wick to remove the excess solder from the pads before placing the new part.

Soldering criteria

The assembly and soldering criteria for SMDs differs slightly from through-hole parts. SMDs are totally dependent upon the solder joint for physically holding the part in position and for proper electrical connection. Improperly mounted parts, such as chip capacitors, may not have a fully soldered terminal if the part is skewed on its pads. This is particularly important in RF circuits where the connection impedance may be higher than expected, creating an unpredictable circuit function.

For SMDs, a solder joint must join each terminal to the appropriate board pad where the solder joint has three important features:

1. Solder wetting of the component terminal area.
2. Solder wetting of the pad.
3. A smooth solder fillet joining the two mated wetting surfaces.

Inspection criteria involve placement of the correct part, orientation, and a proper solder fillet. Broken and damaged parts are unacceptable and must not be used.

Correct solder wetting between the pad and SMD should resemble **Fig. 2**. Look closely at a full solder fillet from the pad to the top of the SMD terminal. Solder fillets on the side of the SMD terminal are optional.

Fig. 3 shows proper wetting on one end of an SMD while the opposite end exhibits improper terminal wetting. The lack of wetting may create an open or intermittent connection. The lack of wetting may occur at the interface between the solder and either the terminal or pad. The correct terminal wetting solder fillet for a round SMD is shown in **Fig. 4**.

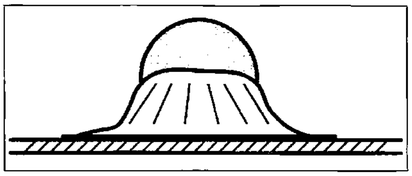


Fig. 4. *Correct wetting for round SMDs.*

Fig. 5 shows a skewed SMD. Although the SMD terminal may be soldered to the pads, the wetting is insufficient and the SMD should be repositioned to achieve the lowest connection impedance.

Chips and similar mechanical damage to the ceramic, glass, or plastic body of the SMD are unacceptable (**Fig. 6**). Although the part may function while damaged, its value may be altered and it may perform unreliably. Cracks in the part body (**Fig. 7**) are unacceptable.

Used SMDs

As a cautionary note, used ceramic and glass SMDs that have been removed from circuit boards with Solder Wick may suffer from terminal plating loss. Ceramic and glass SMDs have terminals of thinly plated-on silver, and during solder removal, some or all of the plating may be removed, preventing the terminal from accepting solder again (see definition of *leaching*). The use of silver-bearing solder reduces the risk of plating loss.

Glossary

Active flux: A chemically active agent that speeds the wetting process of metals with molten solder. When heated, the flux will remove oxides but will not remove oil, dirt, or fingerprints. Upon cooling, rosin flux becomes relatively inactive, but the residue must be removed completely.

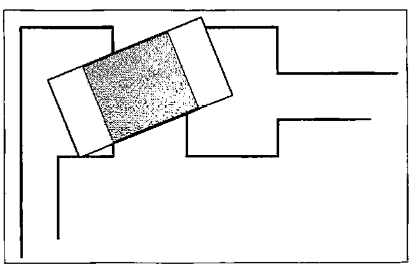


Fig. 5. *Although the SMD terminals may be resoldered to the pads, the wetting is insufficient and the SMD should be repositioned.*

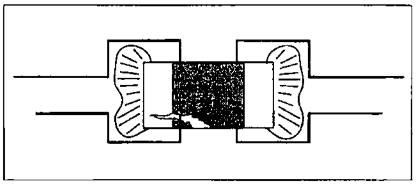


Fig. 6. Chips and similar mechanical damage to the ceramic, glass, or plastic body of the SMD render it unacceptable.

Bridging: The formation of an undesired conductive path between conductors.

Cold solder connection: The required metallic luster is missing and generally the solder joint has the appearance of rough, piled-up solder with a granulated surface. It may also appear chalky and frosted.

Component: Any electrical or mechanical device (resistor, capacitor, integrated circuit, etc.) which has electrical characteristics used in an electrical circuit.

Component terminal: Wires, solid terminal protruding from the body of a component.

Conductor: A single conductive line or area forming an electrical connection between terminal areas.

Connection: The means by which electrical contact is made to the conductive circuit.

Contamination: A material such as oxide, oil, dirt, or fingerprint which is not intended to be part of the process.

Corrosive: A substance is considered chemically reactive or corrosive if it has the ability to degrade a conductive pattern electrically and/or mechanically.

De-wetting: Characterized by solder not completely covering the surfaces to be bonded. Solder may appear as droplets or balls having withdrawn from previously wetted adjacent pads.

Disturbed joint: A joint in which the lead has been moved while the solder was solidifying. The joint will have a dull granular appearance and/or have noticeable cracks.

Fillet: A smooth transition of solder between the parts being joined.

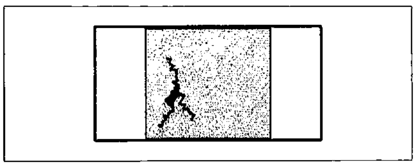


Fig. 7. Cracks in the ceramic body of the SMD are unacceptable.

Flux: See *Active flux.*

Fractured joint: May be identified as a disturbed solder joint exhibiting a dull granular appearance and/or have noticeable cracks.

Granular solder: Solder appearance with a coarse, large grain structure, lacking in metallic luster.

Leaching: A condition where SMD end cap metal disappears as a result of repeated solder operations. Leaching appears as a series of holes or areas where the base metal has been removed from the device end cap.

Non-wetting: A condition whereby a surface has contacted molten solder, but has had little or none of the solder adhering to it.

Oxidation: A form of contamination which prevents proper solder wetting (caused by unprotected metal being exposed to air).

Pad: The portion of a printed circuit or wiring used for making an electrical connection to a component or wire.

Plating: The process consisting of the chemical or electrochemical deposition of metal on all or part of a component terminal or board pad.

Printed circuit: A pattern composed of printed wiring or circuitry formed on a common rigid or flexible base.

Residue: Substance remaining on a circuit board after soldering and cleaning, such as flux, oil, or salts.

Solder: Ordinary soft solder is a fusible alloy consisting of essentially tin and lead used for the purpose of joining two or more metals at a temperature below their respective melting points.

Solderability: The measure of the ability of a metal surface to be wetted by solder.

Terminal: A solder area such as a solder pad where a component lead/terminal will be attached.

Terminal leaching: See *Leaching.*

Tinning: The process of coating conductive parts or terminal areas (pads) with solder for the purpose of increasing solderability.

Void: The absence of a specific metal from a certain area. Voids such as pinholes or blowholes may result from the formation of gas pockets in the surface being soldered.

Wetting: The free flow and spreading of solder on conductive paths and terminals to form an intermetallic bond. 73

El Cheapo

Rub shoulders with the big boys on 20 meters, without shelling out megabucks!

Ron Gang 4X1MK
c/o *73* Magazine

The forgotten collinear will do the trick for you. All you need is a single mast to raise it at the center (inverted-vee style) and a couple of trees to tie the ends to. A bit of real estate is necessary as well, but the 20m version is three-quarters the length of an 80m dipole. Of course you can't rotate it, but those receiving your big signal will never know (unless you tell them).

I say "forgotten," as information about this skywire appears in old handbooks and magazine articles, but in the last 20 years I've seen no mention of it. Of all the stations I've contacted, nobody on the other end of the QSO has reported using a collinear. A few old-timers do know what I'm talking about when describing the antenna, but that's it. So, in the interest of exploiting the past and possibly adding something to it, I take pleasure in re-presenting the horizontal collinear antenna for HF.

The collinear is used widely today in its vertical version for VHF and UHF applications, such as the Ringo Ranger™ and other base and mobile antennas that combine more than one radiating element in line with another (col-*linear*) to give a radiation pattern to the sides with little radiation at the ends. The vertical jobbies have a low angle of radiation, concentrating the signals at the horizon, with little wasted into the sky above while maintaining an omnidirectional pattern—but that's another story.

Fig. 1 shows a diagram of the single-band three-element collinear. (The center section is interrupted in the middle by an insulator and becomes the feedpoint.)

The phasing stubs delay the current in the end elements by 180 degrees from that flowing into it from the center element, so that all three half-waves are working in phase. That causes their wavefronts to join together, making a very strong broadside radiation pattern. Thus the antenna radiates with excellent directivity at right angles to it, receiving consistent signal reports equal to those received with a three-element yagi. Whereas the yagi is unidirectional with a theoretical three-dB lobe of 60 degrees' width, the collinear is bidirectional with two 36-degree three-dB lobes.

My collinear is stretched from the northeast to the southwest, giving me major lobes to the northwest (for great signals into Europe, North America and long path to VK/ZL) and southeast (for South Asia and Oceania). For DXers in North America, I'd recommend stretching it from the northwest to the southeast for good sigs to Europe and the Mid East in one direction and VK/ZL in the other. Of course, your wants will determine how you hang it.

Feeding the antenna

The feedpoint impedance for a three-element collinear is around 300 ohms. It may be fed with a 4:1 balanced-to-unbalanced balun into coax for simple single-band operation, for the band for which it was cut.

For multiband operation, use a balanced feedline directly from the feedpoint of the collinear into the balanced output terminals of an antenna tuner in the shack. In this configuration, a 20m antenna tunes like a breeze for 20, 17, 15, 12, and 10 meters, and has been also successfully tweaked to work

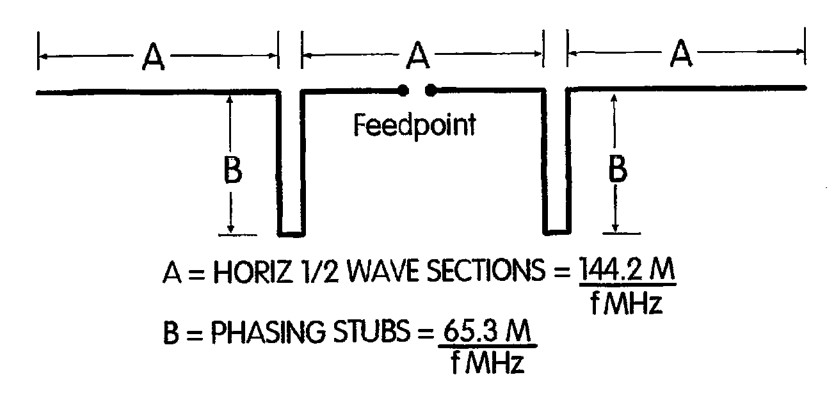


Fig. 1. Construction diagram.

acceptably on 30, 40 and 80. My 20m collinear also gave excellent results on 17 meters into North America. Although on other bands I felt no advantage, the antenna functioned well—at least as well as a simple dipole or random wire. But there was nothing spectacular on those bands for which it wasn't intended. On those bands it is what used to be called a centerfed zepp.

I highly recommend the use of a balanced coaxial transmission line instead of open-wire feeders (see **Fig. 1**). The advantages of the balanced coaxial transmission lines over open-wire are:

1. No extraneous radiation, thus less TVI, BCI, and other "I"s.

2. Less pickup of extraneous signals from computers, TV sets, and the like.

3. The feedline, unlike the open-wire feeders, is not affected by precipitation or proximity to metal objects like your tower, etc.

4. Ease of construction: There is no need to keep the conductors at a constant distance from each other. For aesthetic reasons you may wish to tape the two coaxial cables together at intervals, but this is not necessary.

The balanced coaxial transmission line is constructed from two *equal length* coaxial cables, the shields of which are electrically connected to each other at each end. Any cable will do, no matter what impedance. Incidentally, the impedance of the line is twice the impedance of the individual cables. That means that if you're using 50 ohm coax, the feedline will have an impedance of 100 ohms. But since you're using an antenna tuner, it will take care of such mismatches. At the antenna end, each center conductor of the coax is connected to one of the legs of the collinear. The shields are connected together. In the shack, the center conductors go to the balanced output terminal of the tuner, and the shields which are tied together are grounded.

My antenna is hung in an inverted-vee fashion, with the center at the top of a 10-meter mast on top of a seven-meter-high roof. At the top of the mast is a clothesline-type pulley with plastic-coated steel cable which I use to raise and lower the wires, a great tip for antenna experimenters who don't want to hassle with climbing or raising and lowering masts. The ends droop down to about eight or 10 meters above ground, the extended wires from the end insulators tied onto conveniently located trees.

This configuration may be not quite theoretically ideal, and the antenna might operate possibly better if the ends were be higher up. But I don't think the effort is worth it, judging by the good comparative reports on 20m over the last few years of operation with this wire. After all, 20m is a crowded band, and here the men and women are really separated from the boys and girls.

This antenna costs next to nothing to construct. All you have to do is measure accurately, and hoist it up. I've used various very long wires and vee beams over the years, but on 20m, this baby beats them all. No longer do I feel in the back seat on that band—in the final analysis, it can be truly said that the wire collinear antenna for HF delivers the biggest bang for the bucks!

Adding collinears in parallel

I was quite satisfied with the performance of this skyhook on 20m, the band of my preference for long-haul QSOs; for the forays into the other bands, it worked acceptably. Nonetheless, I found I wanted better performance on 15m, and thought of adding a 15m version at the feedpoint. In all the literature at my disposal I found nothing about connecting antennas of this sort in parallel.

The time had come to be a true ham, and experiment. A 15m version was constructed and connected at the feedpoint, drooping below the 20m antenna somewhat. Since both collinears were made of insulated wire, there was no problem where the phase-delay stubs crossed the 15m wires. It is a bit tricky hanging one under the other, and it's important that the wires of the two collinears don't twist around each other at any point.

The wire I use is stranded copper in a PVC jacket, the cross-sectional diameter being 1.5 square millimeters, roughly equivalent to AWG #18 wire, the type which is used in automobile wiring. I like this wire because it does not kink as does solid wire, and always stretches straight, easily. In North America, I would think that stranded copperclad wire for antennas is readily available, which doesn't slowly stretch over the years as does the soft copper that I use. It's possible that there just may be an ad or two in this magazine for companies selling antenna wire.

The results were rewarding: It worked fine on 15, just as expected. However, there is a certain amount of interaction between the two antennas, and here the antenna tuner and balanced line proved their worth. I don't know how you'd make out here with just a 4:1 balun and a single coaxial line for dual-band operation. I expect it would work, but with poorer SWR.

Stub construction

The multiplicity of ladderline-type stubs (four of them now), is rather a bit unsightly (even in a ham's eye) and makes it rather awkward to manage. A single-band collinear is easier to manage with but two stubs, but when there are high winds, the 15m and 20m stubs have been known to tangle with each other. Twinlead stubs should be more manageable, but you might have to experiment with the length as the velocity factor will be somewhat different than what I used here.

Incidentally, in order to duplicate my stubs, I used the same 1.5-square-millimeter PVC-jacketed stranded copper spaced 2.5 cm (one inch) apart with home-fabricated Plexiglas™ spacers. I constructed the stubs by stretching the two wires between two points, then moving the spacers along the line, fabricating the ladder as it were. Then I dropped epoxy cement at the points where the wires go through the holes in the spacers and let the glue set thoroughly before removing the wires from between their temporary stretching points. However, if you can locate ladderline or twinlead, save yourself the time wasted reinventing the wheel. It's just that in my neck of the woods ladderline is not available.

What's left to be done

In my mind, the stubs are the downside of this skywire. There must be a better way of doing it. Possibly substituting a tuned circuit to effect the 180-degree delay, or maybe hanging pieces of coaxial cable like RG-58 or -59 shorted at the far end instead of the ladderline stubs. The coax, having a 66% velocity factor, should be around 70% the length of stubs I used. No doubt a collinear without the droopy stubs would be more aesthetic in the eyes of a non-ham. (Any antenna is a work of fine art in ham's view!) I'd love hearing from anybody with experience in the stub business in order to further refine this skyhook!

Suggested reading

Dick Silberstein WØYBF, "Collinear Antenna for 20 Meters," *Ham Radio*, May 1976.

ARRL Antenna Handbook, 1972.

John S. Belrose VE2CV, "Tuning and Constructing Balanced Transmission Lines," *QST*, May 1981.

LETTERS

Continued from page 7

some research. I would like to see an article on the construction of the magnetic pulse generator. Even though it is quite easy for some of us to make them without detailed instructions, there are many who cannot get them going. I took my flash gun to a camera technician who made a neat connection to the zener tube without wrecking the gun. I did wreck another flash gun and mounted the PC board and a more powerful zener tube into a neat case and I drive it with a six-volt power pack. It kicks a washer two feet into the air. An excellent method of cleaning the silver electrodes is to use a soft pencil eraser. It polishes and shines them quickly and easily. Keep up the good articles on health in your editorials. I have been a health nut for 50 years and now at age 79 I look no older than 55, and am still as fit as a teenager. On the question of Morse code, I love it. Anyone who takes the time to master Morse code will also be hooked on it—ask any CW buff.

Sure, Frank. I love raw liver, so let's make a law requiring everyone to eat raw liver. Anyway, how about some articles on pulse units? ... Wayne.

APRS Network Guidelines

20 tips for increasing efficiency.

Richard Parry P.E. W9IF
13842 Deergrass Court
Poway CA 92064-2276

The Automatic Position Reporting System (APRS™, a trademark of Bob Bruninga WB4APR) network is significantly different from regular amateur packet networks used for communication. Virtually all amateur packet radio communication uses the connection-oriented form of AX.25, which provides error-free communication. However, APRS uses the connectionless form of AX.25, which is an unreliable protocol in which lost packets are not detected. Therefore, to help ensure reliable communication, operating practices play an important role.

The AX.25 protocol has its roots in the X.25 international standard. However, the commercial version does not meet all requirements of the amateur radio community. A critical limitation of X.25 is the protocol's insistence on knowing the source and target address. For amateur radio, this would make it impossible for a station to call CQ since the destination station at the time of transmission is unknown. To solve this problem, the *unnumbered information* (UI) frame was added to the protocol. It allows the transmission of packets without a unique destination address and does not require an acknowledgment.

Over a decade of packet radio has come and gone, but it was not until fairly recently that the UI packet gave birth to this new type of network. The APRS network is built entirely on the transmission of UI packets. Both fixed and mobile stations broadcast their position at intervals from once a minute to once an hour using UI frames exclusively. However, since there are no acknowledgments for UI frames, lost packets are undetected. In addition, if good practices for APRS networks are not followed, packets are more likely to collide and result in inefficient use of the available bandwidth. Therefore, much of the challenge of reliable communication in these networks is selecting and using good operating practices to accommodate the wide variety of uses, while keeping within the limitations of the protocol.

APRS can report the position of a float in the Rose Bowl parade, the Olympic torch as it travels throughout the United States, or a Boston Marathon runner. It can broadcast their positions across town, and across the country. However, it would be impossible for the network to support position reporting of the daily commute to and from work for all amateurs.

The APRS networking protocol requires users to cooperate to ensure efficient use of the available bandwidth. With these limitations in mind and the need to foster cooperation, the APRS community has developed some generally accepted practices. The guidelines listed below are the result of my operating experience and discussions via the APRS mailing list. An examination will show that many of the guidelines are common sense. However, some are more subtle and require a better understanding of the network.

Lastly, remember that these are guidelines, not rules. For example, a good digipeating path for one station may be bad for another. Factors such as your location and the amount of traffic in your area will play a major role in determining what works for you and your network.

APRS operating guidelines

1. Always use the *minimum* digipath necessary to maintain communications to minimize channel loading and QRM. Remember, the APRS protocol uses UI frames, which does not assure reliable delivery of packets.

2. Fixed stations (e.g., home APRS stations) should not beacon very frequently. Intervals from 20 to 60 minutes are common.

3. Fixed stations which broadcast weather-related information may transmit at frequent intervals. The present standard is every nine minutes.

4. Mobile stations (e.g., moving APRS vehicles) may beacon as frequently as once per minute for special events or

three to five minutes for routine mobile operation. Care should be exercised, with local network conditions taken into account.

5. When a mobile station changes to a fixed station, such as when the station arrives at its destination, the beacon should be stopped or the rate adjusted to meet the new designation as a fixed station.

6. Use APRS VIA WIDE for your path if you are in a metropolitan area where you can hear a WIDE. Better yet, if possible, specify a unique digi (callsign).

7. Use APRS VIA WIDE, WIDE for regional coverage. In a metropolitan area with an active APRS community, you should get coverage up to 100 miles. Better yet, specify a fixed callsign in place of the second WIDE to get better coverage.

8. Fixed stations may set a path of APRS VIA RELAY, WIDE if the WIDE cannot be reached directly. Then when you find out who your local RELAY is, you should specify a unique callsign for the first digi.

9. If you have information for a national audience, use APRS VIA WIDE, GATE to reach an HF gateway. However, this is for rare occasions. The 300 baud HF data rate limits the number of mobiles nationwide to approximately 20. This path may also be used by long-distance travelers with emergency or priority traffic who are near a GATEway.

10. Never use APRS VIA WIDE, WIDE, WIDE since it has the potential to totally saturate a channel with 27 copies of each packet. If you are in a remote area, this may be your only option, so the "never" may be changed to "seldom." Again, use a fixed callsign as the first digi if possible.

11. Although APRS supports keyboard-to-keyboard contacts, extended use of this communication technique is discouraged, especially on the HF where the information rate is 300 baud.

12. All fixed stations should set the TNC's MYALIAS to RELAY. This will vary between various manufacturers' TNCs, but some form of an alias should be set to RELAY. This is true even for mobile stations.

13. Mobile stations should use RELAY, WIDE or RELAY, WIDE, WIDE as a digipeating path for citywide coverage.

14. Do not enable the GATEWAY function of your TNC unless you are the only GATEWAY near your local WIDE. Before setting the GATEWAY function, local coordination with other GATEWAYs is encouraged. This is especially true when an existing GATE already serves your network.

15. Never digipeat on HF unless both stations attempting to pass data cannot hear each other but are known to be online. If you must digipeat on HF, use only one hop. This is typically for emergency or priority traffic only.

16. Whenever possible, use a direct path to chat.

17. If a direct path is not practical, use a specific digipeater callsign in lieu of a generic path such as RELAY or WIDE.

18. When events, information, or data are intended for a specific area, utilize a specific path by designating the exact callsigns of the digipeaters necessary for reliable communication.

19. As APRS popularity continues to grow, the potential for long-range VHF coverage is possible. Ask yourself if your information is of interest to someone a hundred miles away. If not, restrict the path.

20. Consult local experts or experiment to find the best route for your application. Remember, these are guidelines and numerous exceptions exist.

The intention of these guidelines is to provide a working background for the development of efficient APRS networks. Despite the network's apparent simplicity, some of the practices may not be so obvious, even to the advanced user. Most of the guidelines are straightforward when one understands how the network functions and its limitations. Many others are not so obvious and still others may be the point for further discussion. When in doubt, ask the local APRS expert. If you have access to the Internet, the APRS mailing list is an excellent source of information. All you have to do is send mail to the [aprssig@tapr.org] mailing list where you will typically get an answer within hours from a large group of "Elmers" ready, willing, and able to help you. To join the APRS mailing list, send E-mail to [listserv@tapr s.org] with subscribe aprssig FirstName LastName in the body of the message.

Suggested reading

Bruninga, Bob, "Automatic Packet Reporting System (APRS)," *73*, December 1996.

Dimse, Steve, "javAPRS: Implementation of the APRS Protocols in Java," *ARRL and TAPR 15th Digital Communications Conference Proceedings*, Seattle, Washington, September 1996.

Horzepa, Stan, "APRS Tracks: RELAY, WIDE, and Other Paths," *Packet Status Register*, Fall 1996, Issue #64.

Horzepa, Stan, "APRS Tracks: Alias Envy," *Packet Status Register*, Summer 1996, Issue #63.

Horzepa, Stan, "APRS Tracks," *Packet Status Register*, Spring 1996, Issue #62.

Horzepa, Stan, "Getting On Track with APRS," American Radio Relay League, Newington CT.

Parry, Richard, "Position Reporting with APRS," *QST*, June 1997.

Phased Trapped Verticals for HF

Simple ideas, simple to build.

Laurence C. (Curt) Raynes KD7FY
2150 Laura St. #85
Springfield OR 97477

A lot is known about phased antenna arrays—the math for them is well documented, but the little bit I once knew I've pretty much forgotten. Thankfully, for ham use, not much math is needed, and the answers will come quickly by experimenting.

To set up this small array, a pair of Butternut HF6s were mounted on 10-foot poles beside a mobile home with their base feedpoints near the edge of the metal roof, which was used as a ground plane. They were mounted so the line of the antennas was on a north-south axis and were spaced 18 feet apart, which is about 1/8 wave on 40m. Identical lengths of coax were used from each antenna's feedpoint to the phasing box in the shack. To maintain about the same impedance when reversing the pattern, extra care was taken in tuning the trap verticals so they had the same section lengths and dip frequencies. Of course, any like pair of antennas can be used. Different style antennas can also be nulled, but they give less satisfactory pattern reversal.

RG-8/M coaxial cable was used for the feedlines because of availability and price, but any good coax will serve, if the phase delays of the two feedlines are the same. If they are an electrical half-wave in length, they will repeat the antenna base impedance in the shack, but this isn't necessary for good operation—only for measuring convenience.

Simple ideas

Starting with two equal antennas and two equal feedlines, if Line 1 is made longer, then Line 2 is shorter than Line 1. Making Line 2 even shorter increases the difference between their lengths. So if there is a coax delay line retarding the phase of the power to Antenna 1, the antenna-to-antenna phase difference can be made greater by advancing the phase of the power to Antenna 2.

The phase delay to one antenna, plus the phase advance to the other, plus the space phase, which is the free-space distance expressed in degrees between the two antennas, should add up to 180° for an endfire array.

Ideally you should have equal radiation from the two antennas with phase relationships that will subtract in one direction and hopefully add in the other. Operationally, you hear a station, reverse the array pattern and null it, then reverse the pattern again for best reception and transmission. This sounds pretty simple, and it is, but there are a few nice-to-know things when using endfire arrays at high frequencies.

There will be a delay...

The classic example of ham endfire arrays is usually constructed with one delay line. The free-space distance of a half-wave at 7.03 MHz is about 70 feet, and the distance-to-phase relationship is about 0.389 feet per degree; a quarter-wave separation between two antennas is 35 feet, which is 90° of space phase. The antennas will be out-phased to 180° with an additional 90° coax delay line in series with one of the antennas' two equal feedlines.

To make a coax delay line, the coax velocity factor, VF, is needed. The VF is the relationship between free-space velocity and the propagation velocity of coax cable. Tables list the VF for RG-8/M at 0.75, but the RG-8/M I have measures to be 0.73. To find the VF, dip a quarter-wave piece of coax and compare its electrical length to its measured length. Using 0.73, the length-to-phase relationship is 0.284 feet per degree at 7.03 MHz. A 90° delay line of RG-8/M is 25.6 feet long (0.284 x 90 = 25.56).

Such a delay line does not compensate for HF skywave communications, because the effective space phase distance between the two antennas decreases as the skywave angle increases and a longer delay line is needed to make up the difference. For example: The cosine of a 30° radiation angle is 0.866, so the adjusted space phase distance between two antennas with a physical separation of 90° becomes 78° (90 x .866 = 78), and 12° more delay line is needed for a total of 102°. This equates to about 29 feet of RG-8/M for such a delay line.

You could make a switch to add in five-degree increments to a basic delay line. This would be pretty simple and a reasonable way to go, but a five-degree

line for 40m becomes a 10° line at 20m, and suddenly you need a whole bunch of switch points that will handle real power.

I'll take the mismatch caused by the unknown impedance of a variable phase advancing Tee network to get cancellation because the impedance of the array changes with phasing anyway, and all unknowns become moot when you match the system to 50 Ω resistive. Besides this, Tee network phasing works well on other bands too.

The system here is wired so that with the antenna switching relays relaxed, both antennas are connected in phase to the delay line. With one relay coil energized, the Tee phase advance network is connected to one of the antennas, and the coax delay line is connected to the other. This sets up the antennas for an endfire pattern. Opening that relay, and closing the other, reverses the pattern.

This array was a simple north or south system at first and then it was decided to take advantage of a broadside connection for an east and west pattern. In this mode the Tee network is not used and RY3 disconnects it. The delay line is left in the circuit as its loss is minimal. The endfire and broadside impedances are quite different, so the array must be rematched with the antenna tuner when changing between endfire and broadside patterns.

The patterns are quite wide, so a station that is due east or west will not null, and it will come in at about the same signal strength when the endfire pattern is either north or south. This makes you wonder if something has happened to the system. Thankfully, the broadside east and west pattern is better on such stations—especially if they are far away.

A few words about the Tee network

A split stator dual capacitor with its rotor connected through a spinner coil to ground will allow a wide range of phase advances. However, if you are really a diddler, you'll want a small differential dual capacitor connected in parallel with the split stator. It will allow tweaking control over magnitude along with the phase control for the two antennas. My split stator capacitor is about 200 pF per section with 1/10-inch spacing.

This system really works on 40, 30 and 20m. On 40 meters I use a 13-foot delay line and the Tee network makes up the difference. The same line works on 30m. On 20m the antennas are a quarter wave apart and need a little more than 90° of delay, and the Tee network gets it easily. A Tee-type high-pass antenna tuner will function as a Tee phase shifter if it has a spinner coil.

If you live in an area where bad power line or industrial noise is pretty much in one direction, you can null out quite a bit of it with this kind of antenna by setting the null on the horizon towards the noise source. I get about 20 dB of noise reduction from a bad HV line south of me, and can still work high-angle stations in this direction. Also, touch and glow lamps are a pest, and often these can be nulled. You can't work 'em if you can't hear 'em and this antenna lets me hear 'em.

A small 1:1 transformer is used to isolate the 115 VAC used by the switching relays. These relays have low coil-current requirements which makes possible the use of good old-fashioned 2.5 mH, segmented RF chokes to isolate the relay coils from ground and allow them to switch higher voltages. They hold OK at a kilowatt. The RF chokes are not needed at the 100 W level.

The relays are split-core, and are DPDT with 10 A contacts. They are inexpensive and work well, but I do pull off their caps and dress the leads away from their metal frame before using them.

This project is high fun for a tinkering ham, and if in the past you have worked as an AM broadcast tech, you'll find it kind of neat to own your personal directional array. 73

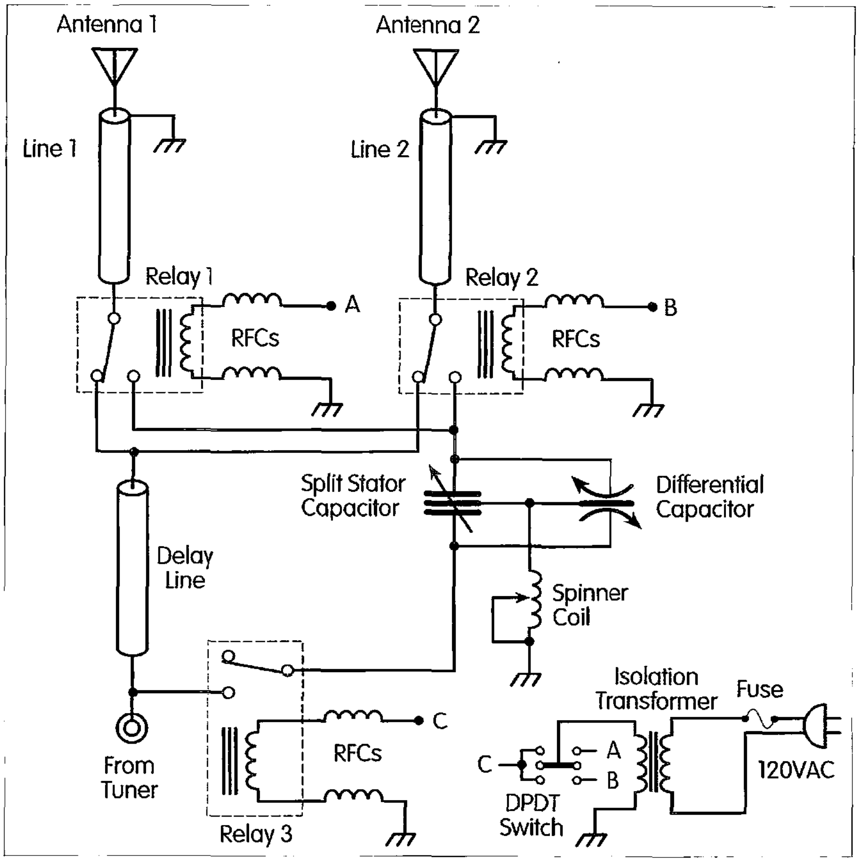


Fig. 1. Circuit diagram of the variable phase advancing Tee network used with two trap verticals.

UNITED STATES POSTAL SERVICE(TM) Statement of Ownership, Management, and Circulation (Required by 39 U.S.C. 3685)(1) Publication Title: 73 Amateur Radio Today (2) Publication No.: 1052-2522 (3) Filing Date: 08-20-97 (4) Issue Frequency: Monthly (5) No. of issues Published Annually: 12 (6) Annual Subscription Price: $24.97 (7) Complete Mailing Address: 70 Route 202 North, Peterborough. Hillsborough Cty., NH 03458-1107 (8) Complete Address of Headquarters or General Business Office of Publisher (Not Printer): *70 Route 202 North, Peterborough, NH 03458-1107 (9) Full Names and Complete Mailing* Addresses of Publisher, Editor, and Managing Editor: S.S. Green, 70 Route 202 North, Peterborough, NH 03458; S.S. Green, 70 Route 202 North, Peterborough, NH 03458; F.L. Marion, 70 Route 202 North, Peterborough, NH 03458 (10) Owner: Shabromat Way Ltd., P.O. Box 60, Hancock, NH 03449; Sherry Smythe-Green, P.O. Box 60, Hancock, NH 03449 (11) Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities: None (12) (For completion by nonprofit organizations (13) Publication Name: 73 Amateur Radio Today (14) Issue Date for Circulation Date Below: May 1997 (15) Extent and Nature of Circulation; *Average No. Copies Each Issue During Preceding 12 Months; Actual No. Copies of* Single Issue Published Nearest to Filing Date (a) Total No. Copies (Net Press Run) 63,180; 60,612 (b) Paid and/or requested Circulation - (1) Sales Through Dealers and Carriers, Street Vendors, and Counter Sales (Not Mailed) 11,158; 12,280 (2) Paid or Requested Mail Subscriptions (include Advertisers' Proof Copies/Exchange Copies) 20,128; 18,843 (c) Total Paid and/or Requested Circulation (Sum of 15b(1) and 15b(2) 31,286; 31,123 (d) Free Distribution by Mail (Samples, Complimentary, and Other Free) 582; 582 (e) Free Distribution Outside the Mail (Carriers or Other Means) 0; 0 (f) Total Free Distribution (Sum of 15d and 15e) 582; 582 (g) Total Distribution (Sum of 15c and 15f) 31,868; 31,705 (h) Copies Not Distributed (1) Office Use, Leftovers, Spoiled 55; 55 (2) Return from News Agents 31,257; 28,852 (i) Total (Sum of 15g, 15h(1), and 15h(2)) 63,180; 60,612 Percent Paid and/or Requested Circulation (15c/15g x 100) 98%; 98% (16) This Statement of Ownership will be printed in the October '97 issue of this publication. (17) Signature and Title of Editor, Publisher, Business Manager, or Owner: Sherry Smythe-Green Date: 08-20-97 I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions *(including fines and imprisonment)* and/or civil sanctions *(including multiple damages and civil penalties)*.

Simple Signal Injector/Tracer

Troubleshooting made easy.

J. Frank Brumbaugh W4LJD
P.O. Box 30 - c/o Defendini
Salinas PR 00751-0030

Over time, resistors can change value. Capacitors can leak, or develop shorts or opens. Transistors, ICs, and diodes can be damaged by voltage spikes. A cold solder joint can open, or become a poor diode junction. In home-brew equipment, the chance of a wiring error or the right part in the wrong place is often the cause of poor or no operation. Mono and stereo amplifiers get a lot of use, as do the audio circuits in SSB transmitters. Because, after your antenna, your receiver is the most important part of your ham station, it is imperative that it operate as properly and consistently as possible, no matter its age or history.

Signal injection and tracing is the simplest way to locate and isolate a defective or inoperative stage in both audio equipment and radio receivers. These techniques allow rapid troubleshooting and repair. The simple circuit described here will allow you to isolate any problem to a specific stage in your equipment, from the antenna connector in your receiver or the audio input to your stereo to the speaker or headphone jack. It uses just two inexpensive integrated circuit chips (ICs) and a couple dozen common parts. It can be constructed in two or three hours at a cost of less than 10 dollars, even using all new (surplus) parts, and much less if you have even the beginnings of a junk box. It is cheap insurance to keep all your equipment "on its toes."

The circuit

Fig. 1 is the schematic diagram of the Signal Injector/Tracer. Power is supplied by BT1, a 9-volt battery, and controlled by S1, a 2-pole 4-position (wafer) switch. SI allows use of either the injector or tracer circuit alone, or both at the same time, depending upon circumstances. LEDs illuminate to indicate which circuit is in use.

U1, a 555 timer IC, is connected as a square wave oscillator operating at about 1,000 Hz. This signal is routed from pin 3 to a probe containing C10, and a 0.01 µF ceramic capacitor which isolates the DC voltage on pin 3 from the equipment being checked, as well as isolating its voltage from this instrument. Because the signal generated is a sharp square wave, it contains many harmonics throughout much of the radio spectrum. This makes it useful to inject signals from RF through audio.

U2, the signal tracer, is an LM386 audio amplifier IC configured for maximum gain. Input from the equipment under test is applied through a probe containing a 0.01 µF monolithic isolation capacitor, C11, and a shunt diode detector, D1. This allows tracing a signal from RF through audio frequencies. Signal level is controlled by LEVEL control R3, a 10k audio taper potentiometer. Output from U2 is routed to headphone jack J1 and to an optional 8-ohm speaker, LS1.

Construction

Except for the two probes, this instrument should be constructed on a small piece of perfboard, or one of the general-purpose printed circuit boards available from Radio Shack™. An enclosure should be used in the interest of neatness. An aluminum or plastic box, or one made of printed circuit board material, can be used.

Lead lengths and parts placement are relatively unimportant except as follows:

C5 (10 µF electrolytic) should be mounted at the end of U2 where pins 1 and 8 are located.

C7 (470 µF electrolytic) should be mounted as close to the body of U2 as possible, with minimum lead length to pin 6.

C4 (470 pF ceramic disc) should be mounted for minimum lead lengths to pins 2 and 3 of U2. Its function is to prevent U2 from picking up stray RF,

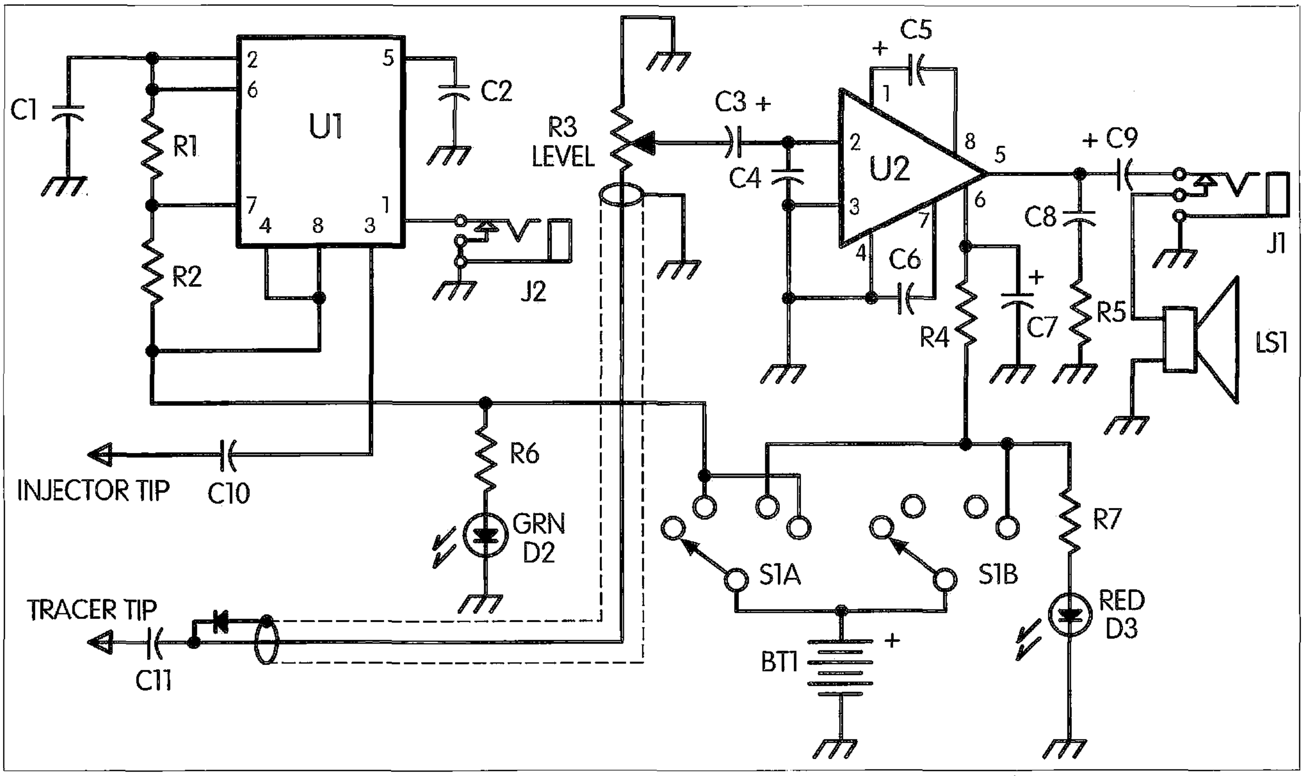


Fig. 1. Signal Injector/Tracer, schematic diagram.

including that from local AM broadcast stations.

Jacks J1 and J2; LEDs D2 and D3; switch S1; LEVEL control R3; and speaker LS1 if included, should be mounted on the panel. Probe cables should enter the enclosure through grommeted holes in the panel and are hard-wired into the circuits.

Probe bodies are specified as test prods, but you can make similar probes from old ball-point pen bodies as long as you have a strong metal tip. Test prod bodies are easiest to use. Connect C10 (0.01 µF monolithic) to the open end of the injector probe wire, which is a stranded insulated wire. Remove the tip from the test prod P1. Insert the probe wire and C10 through the probe body and connect the lead from C10 to the probe tip. Secure the probe tip into the probe body. To prevent pulling the probe wire loose from the body, inject some hot glue or silicone rubber into the probe body where the wire emerges, and let it sit to solidify.

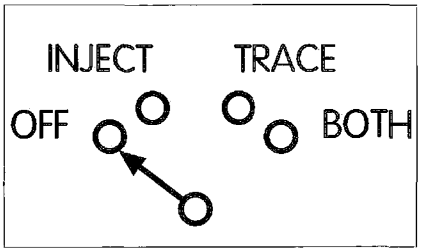


Fig. 2. Identification of switch positions.

Because the tracer probe uses shielded wire, strip back the outer insulation about a half-inch and strip the inner conductor 1/8-inch. Solder one end of C11 (0.01 µF monolithic) to the center conductor. Remove the probe tip. Slide the shielded wire and C11 through the probe body. Now solder the cathode of the D1 germanium diode to the junction between C11 and the inner conductor of the probe cable. Hold the diode lead with needlenose pliers or an alligator clip while soldering and until the joint has cooled. Now solder the diode anode lead to the shield of the probe cable. Clip off excess leads. Inspect it closely to ensure the diode is not shorted out. It must have its body snugged up against the probe cable so it will fit within the probe body. Secure the probe tip to the body. Inject some hot glue or silicone rubber into the probe body where the cable emerges and set it aside to solidify.

Battery BT1 can be mounted in a clip inside the case, or a strip of self-adhesive hook-and-loop strip such as Velcro® can be used.

Operation

This instrument provides three modes of operation. It can inject a signal into a powered piece of equipment which contains a speaker, or with headphones plugged in. It can also trace an existing or injected signal through powered equipment. It can also both inject and trace a signal through a powered but defective or non-operating receiver or amplifier. Both signal injection and tracing will be discussed separately, below.

Caution

Although the procedures described here are the same whether the equipment being checked is powered by a battery, a separate low voltage DC power supply, or a vacuum-tube type whose line cord plugs into the household 120 VAC service, you must be extremely careful when working on any equipment powered by the AC line.

Signal injection

Open the equipment to be checked, to provide access to all stages from input to output. Turn the equipment on. Check with a voltmeter that operating voltage is present and is correct. Rotate any gain

controls fully clockwise, or slide controls to maximum gain. If the equipment has a speaker or if you are using headphones, you may hear some noise—possibly signals if it is a receiver. What you hear may be weak, or you may hear nothing at all.

If the equipment contains vacuum tubes, connect a 0.1 µF 500 V capacitor to the probe tip and use the other lead of the capacitor as a probe. This is necessary to protect this instrument from excessive voltages higher than the working voltages of the isolation capacitors in the probes.

Turn S1 to INJECT. The green LED will illuminate. Touch the injector probe to the output of the audio amplifier. You should hear the signal in the speaker or earphones. If the speaker does not reproduce the signal, it is either defective or a connection has come loose.

Touch the probe to the input of the audio amplifier. You should hear a loud signal. If none is heard, or if it is very weak, the stage is defective.

Touch the probe tip to the input of the preceding stage. If this signal is ahead of the volume control, it is good. Adjust the volume control to reduce signal level. If the volume control does not reduce the signal it probably requires replacement.

Continue these steps, touching the probe tip at the input to each stage from output to input, reducing the equipment's volume control as required. Where volume drops, is intermittent, or there is no signal at all, you have found the defective stage.

The above procedure assumes the equipment being checked exhibits some life but is not functioning properly. If a stage does not seem to amplify, or will not pass a signal as you work from output to input, you will then use normal troubleshooting procedures to isolate and replace the defective component. It will usually be easiest to replace suspected components one at a time, checking with the signal injector after each is replaced, until the problem is solved.

Signal tracing

With the equipment powered up and proper operating voltages present, rotate all gain controls and slide controls to maximum gain. Be extremely careful if the equipment contains vacuum tubes! It is assumed that if the equipment seems "dead," there is no audio output. However, if a 60 or 120 Hz hum is heard, especially in vacuum tube equipment, at least one problem could be defective power supply filter capacitors.

Connect an antenna if you are checking a receiver, or a source of audio if checking a mono or stereo amplifier, to the input. Set S1 at TRACE. The red LED will illuminate. Touch the probe tip to the output of the first (input) stage, and adjust R3 as required. If the signal is heard, touch the probe tip to the output of the next stage. Continue checking stage by stage until you locate the defective stage. It should be necessary to increase the setting of R3 as each stage is checked, to maintain the same audio levels in LS1 or the headphones. A stage which exhibits a very low or distorted output, or none, contains the source of the problem. Again, normal troubleshooting procedures as described earlier will enable you to locate and fix the problem.

Signal injection and tracing

Very often it is easiest to both provide the signal and trace it through the equipment to be checked. Set S1 at BOTH. Follow the procedures described in the preceding paragraphs, injecting and tracing the signal through the circuit to isolate the defective stage.

In a pinch, with a receiver operating correctly, it is possible to inject a signal at the antenna connector with the antenna disconnected, and tweak the IF transformer tuning for maximum output to the speaker or headphones. This will result in maximum receiver gain.

A bonus

If you installed J2 in the lead from pin 1 of U1 to ground, you can use this instrument as a code practice oscillator. Turn S1 to BOTH. Connect both probe tips together—you can use a clip lead. Plug a key or keyer into J2.

Comments

You should, of course, possess the schematic diagram for the equipment you are checking out. Also, having the service manual will make your job easier because it describes how each stage functions when operating properly. It also provides the nominal DC voltages normally present at selected points in each stage.

In solid state equipment, if neither the schematic nor service manual is available, the following tips may be of assistance.

The input to a transistor is usually to the base or gate, but may be to the emitter or source in some circuits. The output will usually be from the collector or drain, but in some cases may be from the emitter or source. You must know the pinout of transistors. Pre-1995 *ARRL Handbooks* provide many pinout diagrams. Manufacturers' databooks, although very expensive, will also suffice, but most electronic equipment uses semiconductors from many manufacturers.

Many older vacuum tube radios and audio amplifiers often have a schematic diagram pasted inside the cabinet or on a baseplate. An old *RCA Tube Manual*, which a few older hams may still have, provides pinouts for many different receiving tubes. Also, the pre-1995 *ARRL Handbooks* illustrate many vacuum tube pinouts.

Input to vacuum tubes is almost always to the control grid—the grid closest to the cathode or filament. In a very few cases, especially with triode tubes, the input can be to the cathode. Output is normally from the plate, although occasionally it will be the cathode when the plate is bypassed for AC.

It is impossible to generalize about integrated circuits (ICs). There is very little standardization, necessarily because each contains a large number of transistors, diodes, resistors, etc., and are manufactured for specialized purposes in the main. Other than manufacturers' databooks, the best sources are schematic diagrams in recent *ARRL Handbooks*, as well as in the ham magazines and books and magazines devoted to construction of electronic circuits, all of which provide pinouts of all semiconductors used in their schematics.

Although signal injection and/or tracing can easily isolate the malfunctioning stage—and very rarely will more than one stage be affected—you will still have to locate what component or components associated with the stage caused the problem.

In vacuum tube equipment it is usually a defective coupling or bypass capacitor, or possibly a resistor which has changed value. In a few cases the tube may simply be worn out, a short or open may have developed internally, or the tube may be gassy. If a vacuum tube does not glow when power is applied, it is likely that the heater or filament is

open—burned out. In an AC-DC radio receiver in which *none* of the tubes glow, the likeliest problem is an open heater in one tube, because all tube heaters are wired in series in these radios. Pull one tube at a time and check between the heater pins for continuity with an ohmmeter. An indication higher than just a few ohms indicates an open heater. The tube will have to be replaced.

In solid state equipment a shorted coupling capacitor can destroy a transistor or IC, and may also overstress associated resistors. An open coupling capacitor will prevent the following stage from functioning. Film dielectric capacitors are notorious for developing opens, but no type of capacitor is immune. A resistor which has been stressed can change its value, which can affect transistor bias or allow excessive current to flow, which can destroy a transistor or IC. Diodes can also develop opens and shorts which can adversely affect operation and, in some cases, overstress resistors or destroy other semiconductors.

In all types of electronic equipment, open or shorted bypass capacitors can cause all kinds of difficulties. Screen grid and cathode bypass capacitors in vacuum tube equipment which go open will prevent normal operation, as will a shorted cathode bypass capacitor. A shorted screen grid bypass capacitor will halt all operation immediately.

In solid state equipment open bypass capacitors can cause poor or no operation. Shorted bypass capacitors not only affect or halt operation, they will result in overstressed resistors and excessive base bias in the following stage, probably destroying the transistor and overstressing other resistors.

When replacing defective components, use identical parts if at all possible, especially semiconductors. In most cases you can replace a resistor with one whose value is within ten percent of the original as long as it has the same or higher wattage. Capacitors should have the same nominal value but especially be of the same type with the same or higher voltage rating. It is especially important to replace a capacitor with one having the same dielectric.

However, generally speaking, silver mica and film dielectric capacitors can be substituted for each other. So can NPO and COG capacitors. The common ceramic disc and monolithic capacitors can generally equally be interchangeable. When substituting an aluminum electrolytic capacitor for a tantalum capacitor, the value of the aluminum capacitor must be at least ten times that of the replaced tantalum, and of the same or higher working voltage. However, the aluminum capacitor will be considerably larger physically than the tantalum it replaces, and there may not be room for it. 73

Part	Description
BT1	9 V alkaline battery
C1, C8	0.1 µF ceramic disc
C2, C6	0.01 µF ceramic disc or monolithic
C3	1 µF 16 V electrolytic
C4	470 pF ceramic disc or monolithic
C5	10 µF 16 V electrolytic
C7, C9	470 µF 16 V electrolytic
C10, C11	0.01 µF monolithic
D1	Germanium diode: 1N34, 1N60, 1N90, 1N270, etc.
D2	Green LED
D3	Red LED
J1, J2	Closed circuit phone jack, builder's choice
P1	Black test prod
P2	Red test prod
R1, R2	6.8k 5% 1/4 W
R3	10k audio taper potentiometer
R4	22 Ω 5% 1/4 W
R5	10 Ω 5% 1/4 W
R6, R7	2.2k 5% 1/4 W
S1	2-pole 4-position rotary (wafer) switch
U1	555 timer IC
U2	LM386 audio amplifier IC

Miscellaneous:
Flexible insulated wire for injector probe
Shielded wire or RG-174U for tracer probe
2 grommets
4 rubber feet
1 battery clip
Enclosure
LSI speaker (optional)

Table 1. Parts list for Signal Injector/Tracer.

Where's the Manual?

Tracking down those vintage gems.

David L. Thompson K4JRB
Resource Solutions
4166 Mill Stone Court
Norcross GA 30092

Watching the messages on the various Internet reflectors or just listening to those who acquire "mature" equipment, the biggest need is to get a manual or schematic (or both). Whether the equipment is old tube-type or modern solid state the question is: How do we get a manual?

There are several ways. Usually the first is asking a friend if you can make a copy of his or her manual. Next we put a request on the swap net, local bulletin board, or Internet reflector or newsgroup—but even if you do find someone with the desired manual, the results are unpredictable, depending on the copier and the price. Jack Hill W4PPT/W4KH, who runs the Internet boat anchor reflector, made an astute observation after he saw my request for a copy of a manual. He said, "A (photo)copy can be much more expensive than an original." The Collins R-388 manual is 125 pages front and back, before 15 or 20 pages of fold-out schematics. The copy alone would cost $25 before any shipping, handling, or trying to find a copier for the larger pages. Most agree that an original is the best approach if one is available. Perhaps someone has a copy he no longer needs and you can buy it. This can be a lengthy search, and all the while the equipment is sitting there waiting. If you don't want to wait, then try one of several sources that provide high quality reprints or reasonably-priced bound copies. Sometimes they even have original manuals.

Obtaining a manual from a manufacturer like Drake, Collins or Heath requires you to know more than just the equipment model number (for Heath, hopefully you've read the articles on their manual numbering schemes in recent issues of *Electric Radio*). The newer manufacturers only offer manuals for about three to five years after the product is obsolete, but fear not—there are numerous firms that offer manuals for specific manufacturers.

Brock Publications is the primary source for all Swan, Cubic, Siltronix, and older Atlas gear. Surplus Sales of Nebraska has a complete line of Collins manuals. Maximilian Fuchs KA1OC supplies National Manuals, Robert Fowle specializes in Hammarlund, and ARDCO Electronics has Hallicrafters service manuals. ARTSCI, Inc., even publishes a book called *Lost User's Manuals*. In response to the market, a number of general manual providers have grown up in the past few years. These include W7FG Vintage Manuals, Hi-Manuals, and The Manual Man, Pete Markavage.

Schematics are often more important than the actual manual. Hopefully the manual you obtain will have the schematic, but if not, don't panic. There are sources for schematics, too. Puett Electronics and Radio/TV/Ham Schematics provide schematics for most equipment from 1920 to 1970. Puett has a regularly-updated catalog, and Alton Bowman W2ZUX, of Radio/TV/Ham Schematics goes so far as to say that if he doesn't have it (the schematic), "You probably don't need it!"

Military and test equipment manuals are in demand, too. Fair Radio Sales, Rainy Day Books, and Frank Lee stock manuals for military equipment, but it's hit or miss. Some, such as Rich Mish of MILTRONIX, specialize in R390A. The Government Printing Office and the Center for Legislative Archives are sources, too. Many hams are restoring and using old military gear (KWM-2, R390, SP 600, and AR-88s). Test equipment to help restore this equipment may have been replaced by digital in commercial shops, but amateurs have provided a second wind to VTVMs, analog generators, and even tube testers. Daniel Nelson specializes in the popular TV-7 tube tester and provides upgrades, as well as manuals.

So, if your equipment did not come with a manual and/or a schematic don't despair—just use the Internet, the

phone, or the mail and get that manual! Here's a handy source list to aid you in your quest.

Manuals: Operating & Service

A.G. TANNENBAUM
A.G. Tannenbaum WB2BTB
P.O. BOX 386
Ambler PA 19002
(215) 540-8055; 24-Hour FAX (215) 540-8327
Service and operating manuals for ham, hi-fi, test equipment of all ages. Free catalog.

ALINCO ELECTRONICS, INC.
438 Amapola Ave., Suite 130
Torrance CA 90501
(310) 618-8616
Alinco manuals only.

ANTIQUE ELECTRONIC SUPPLY
6221 South Maple Ave.
Tempe AZ 85283
(602) 820-5411; Fax: (602) 820-4643
Pre-1960 service manuals for many electronic products and communications receivers.

ARDCO ELECTRONICS
P.O. Box 95
Berwyn IL 60402
Hallicrafters Service Manuals, amateur and SWL.

ARTSCI, INC.
P.O. Box 1428
Burbank CA 91507
(818) 843-4080; FAX: (818) 846-2298
E-mail: [Artsci@aol.com]
Publisher of *Lost User's Manuals*, over 150 pages of operating instructions for ICOM, Kenwood, Yaesu and Alinco VHF and UHF amateur radios. At your dealer or buy direct. Free catalog.

BROCK PUBLICATIONS
Grace Brock
P.O. Box 5004
Oceanside CA 92052
(619) 757-0372
Manuals available for all Swan, Cubic Communications, Siltronix, and Atlas gear.

CENTER FOR LEGISLATIVE ARCHIVES
National Archives
Washington DC 20408
(202) 501-5350
US Army Technical Manuals for radio equipment manufactured from 1940 to 1979. Photocopies for 25¢/page, $6.00 minimum order. A booklet titled *Indexes and Lists to Army Technical and Administrative Publications 1940-1979*; *The National Archives Microfilm Publications Pamphlet Describing M1641*, describes how to determine the proper Army technical manual number.

DRAKE COMPANY, R. L.
P.O. Box 3006
Miamisburg OH 45343
(800) 937-2530
(513) 746-6990 Service/technical
Drake product manuals only.

EICO ELECTRONICS INSTRUMENT CO., INC.
363 Merrick Rd.
Lynbrook NY 11563
(516) 599-5744
Eico manuals for the last 25 years. Calls are accepted on Monday, Wednesday, and Thursday, from 8:30 a.m. to 2:30 p.m. ET.

ELLIS ELECTRONICS
Kirk Ellis KK4YP
203 Edgebrook Drive
Pikeville NC 27863
(919) 242-6000 voice/FAX
Manuals/schematics for Eico, Heath, HP, B&K, and other brands of test equipment.

FAIR RADIO SALES
P.O. Box 1105
Lima OH 45802
(419) 227-6573; FAX: (419) 227-1313
Manuals for surplus equipment. Also some Tektronix manuals and vacuum tube data. Catalog available.

ROBERT FOWLE
1215 Winfred
Jackson MI 49202
[http://207.51.159.231:80/hammarlund/]
E-mail: [hammarlund@jacksonmi.com]
Manuals for Hammarlund and Hallicrafters. Some other vintage manuals.

FRANK, LEE
P.O. Box 60011
Harrisburg PA 17106-0011
(717) 564-4529; FAX: (717) 564-3123
Largest collection of military technical manuals in the world. $5.00 for list, refundable with first order.

HEATH COMPANY
(800) 253-0570
Copies of Heath manuals.

HI-MANUALS
Box K-802
Council Bluffs IA 51502
Manuals for most ham gear made 1935–1970, plus Kenwood. $3 for current list.

SAMS, HOWARD W. & CO.
2647 Waterfront Parkway East Dr.
Suite 300
Indianapolis IN 46214-2041
(800) 428-7267; FAX: (800) 552-3910
Sams provides *Photofact* and manufacturers' service manuals for TVs, antique, ham, CB radios, VCRs, computers, and other equipment. Index catalog available for $5.95 + $1 s&h.

ICOM AMERICA, INC.
2380 116th Ave. NE
Bellevue WA 98004
(206) 454-8155; Brochure Hot Line: (206) 450-6088
Manuals for most ICOM equipment.

KENWOOD (EAST COAST)
East Coast Transistor Parts, Inc.
2 Marlborough Rd.
W. Hempstead NY 11552
(800) 637-0388

KENWOOD (WEST COAST)
Pacific Coast Parts Distributors, Inc.
15024 Staff Ct.
Gardena CA 90248
(800) 421-5080 (outside CA) (800) 262-1312 (CA only)

LAND AIR COMMUNICATIONS
95-15 108th Street
Richmond Hill NY 11419
(718) 847-3090; FAX: (718) 849-8279
Extensive library of service manuals, operating manuals, and schematics for most amateur gear and test equipment.

MANUAL MAN
Pete A. Markavage WA2CWA
27 Walling Street
Sayreville NJ 08872-1818
(908) 238-8964 voice/FAX
Vintage original or replicated manuals for amateur, audio, and radio-related equipment. Manufacturers include Lafayette, Clegg, Drake, Eico, Hallicrafters, Hammarlund, etc. All schematics are replicated full size or on 11

by 17 sheets and bonded professionally. Send two first class stamps for free catalog.

MAXIMILIAN FUCHS KA1OC
11 Plymouth Lane
Swampscott MA 01907
(617) 599-6155
National Radio Company manuals and NCL2000 parts. Send SASE for list.

MECCA
W.L. Horton
1132 Conway Drive
Newark OH 43055
(614) 522-4944
Test equipment maintenance manuals for sale. Send SASE for quote/list.

MOSLEY ELECTRONICS
10812 Ambassador Blvd.
St. Louis MO 63132
(800) 325-4016
(314) 994-7872; FAX: (314) 994-7873
Mosley manuals and parts.

MUSTY MANUALS
645 Wheeling
Wheeling IL 60090
(708) 634-6467
General selection. Catalog available.

NTIS
5285 Port Royal Road
Springfield VA 22161
(703) 487-4650; FAX: (703) 321-8547
[http://www.ntis.gov/]
Military radio and test equipment manuals.

DANIEL NELSON
1025 E. Desert Lane
Phoenix AZ 85040
(602) 243-7421
E-mail: [djn@indirect.com]
Specializes in the TV2 and 7 tube testers.

OLDE TYME RADIO COMPANY
Howard W. Granoff
2445 Lyttonsville Road, Suite 317
Silver Spring MD 20910
(301) 587-5280 voice/FAX
Antique manuals mainly for vintage test equipment. Send 2-stamp large SASE for flyer.

PUETT ELECTRONICS
P.O. Box 28572
Dallas TX 75228
(214) 321-0927 or (214) 327-8721
Schematic diagrams and manuals for most older communications receivers and ham equipment. 67-page catalog for $5.00.

RADIO/TV/HAM SCHEMATICS
Alton H. Bowman W2ZUX
4172 East Avenue
Canandaigua NY 14424-9564
Operating/service manuals for many makes and models of amateur equipment, mainly from 1920 to 1970.

RAINY DAY BOOKS
Frank Bequaert
P.O. Box 775
Fitzwilliam NH 03447-0775
(603) 585-3448; FAX: (603) 585-9108
Military radio manuals, 1930s to 1960s. Some older amateur radio manuals.

ROBOT RESEARCH INC.
5636 Ruffin Rd.
San Diego CA 92123
(619) 279-9430
Robot manuals only.

RAYMOND SARRIO COMPANY
6147 Via Serena
Alta Loma CA 91701
[http://www.csz.com/sarrio.html]
Thousands of manuals available, new and antique.

SONY PUBLICATIONS
P.O. Box 20407
Kansas City MO 64195
(816) 891-7550
Sony products only.

SURPLUS SALES OF NEBRASKA
1502 Jones St.
Omaha NE 68102
(402) 346-4750
Complete line of manuals for Collins. SASE for price and availability.

TEN-TEC INC.
1185 Dolly Parton Parkway
Sevierville TN 37862
(800) 833-7373
Ten-Tec products only.

US ARMY MILITARY HISTORY INSTITUTE
Attn: Historical Reference Bldg. 22
Carlisle Barracks
Carlisle Barracks PA 17013-5008
(717) 245-3611
Technical manuals for military radio equipment. Include the manual number with your request; if unknown, include complete description of equipment with model name, numbers and time period in which the equipment was in use. Manuals are loaned through interlibrary service, or photocopies are available for $10.00 plus 25¢ for each page beyond 10 pages.

VARIAN ASSOCIATES, INC.
301 Industrial Way
San Carlos CA 94070-2682
(800) 432-4422
EIMAC power grid tube data for tubes from 1 kW to 2.5 mW plate dissipation.

W7FG VINTAGE MANUALS
Gary and Karolena Gompf
3300 Wayside Dr.
Bartlesville OK 74006
(918) 661-8237; Orders: (800) 807-6146
[http://www.w7fg,com/]
2500 manuals in stock; immediate turnaround. Manuals bound with cardstock covers. Vintage to present day. 24-hour service. Manuals sent postpaid; phone orders welcome. SASE for list.

WESTERN NEBRASKA ELECTRONICS
HC-84, Box 1
Potter NE 69156
(308) 879-4552
Complete collection of Collins manuals. $12.50 for reprint or $35.00 for a printed copy.

YAESU USA
17210 Edward Rd.
Cerritos CA 90701
(310) 404-2700
Yaesu products only.

Trees Are for the Birds

The ham's secret weapon—PVC!

Peter A. Bergman NØBLX
3517 Estate Dr. SW
Brainerd MN 56401

When I moved from a trailer court to a house on a half acre in the country, I thought that all my HF antenna problems were solved. I had been using a 40-10 trap vertical clamped to the hitch on the mobile home but now I had room and I had trees. I could hang all the wire antennas I wanted from the tops of those lovely trees.

Well, sort of. For one thing, all the larger trees are at the back of the lot and the tallest tree in the front of the house is still only eight feet tall. I think we have all heard the joke about the elephant and the acorn, but I wasn't willing to wait twenty years.

After one particularly frustrating afternoon spent trying to shoot a line over the top of my tallest tree, I knew that something else had to be done. Slingshots are for kids and trees are for the birds.

What I wanted was something that was readily available, easy to work with, durable, and cheap. Since I am involved in Civil Air Patrol communications, I wanted to produce a mast that was easy to store, transport, and set up. And cheap. With that in mind, I started to experiment.

I was already using a mast made of two sections of three-inch schedule 40 PVC to support the feedpoint of a pair of inverted vee dipoles. It worked, but I wasn't happy with it. I wanted more height and I wanted it to be stronger and straighter. The sections were joined with a standard pipe coupling. It seemed that no matter what I did, the top wanted to lean one way or the other—sometimes both ways at the same time! I had joined the coupler to the pipe sections with bolts and large sheet metal screws instead of PVC cement because I didn't want to have to use a saw to take it apart. A few too many trips to the Saint Solenoid Day Festival and all I'd have is a lot of short pieces.

I decided to continue working with PVC, but needed a better method of joining the mast sections. I had tried telescoping successive sizes but that didn't seem to work very well either. Finally I hit on two methods that I really like.

First, I cut some scrap three-inch-diameter ABS pipe I had in the junk box and split it lengthwise with a saber saw. A table saw would have worked better, so use it if you have one. Then I measured the length to find and mark the middle. Joiners less than one foot long don't seem to do the job, but more than two feet seems wasteful. Next comes the

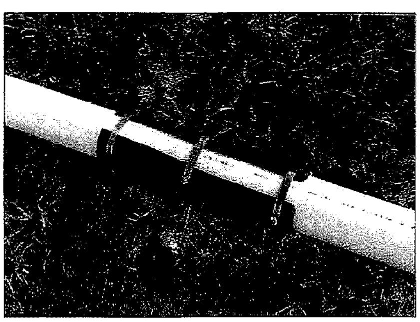


***Photo A.** Joint detail.*

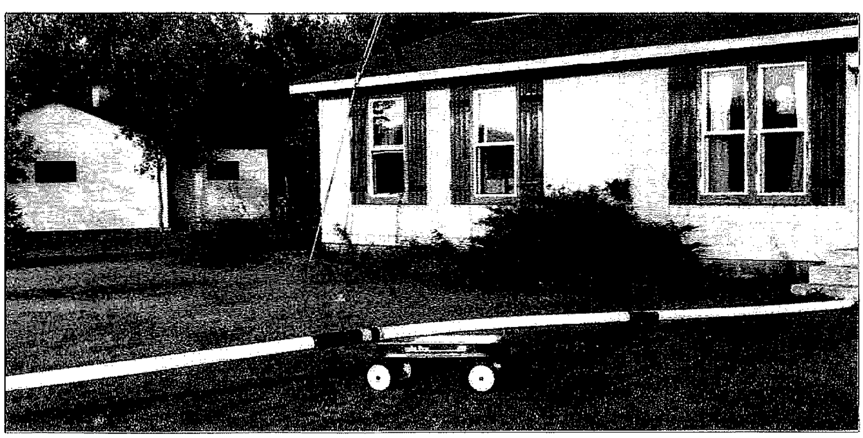


***Photo B.** Strong but flexible.*

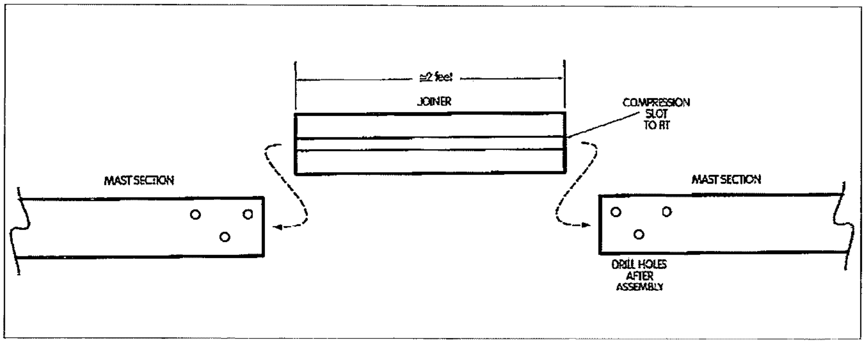


***Fig. 1.** Internal joint.*

tricky part: sliding the joiner over the mast sections.

For its weight, schedule 40 PVC is strong and very springy. The best tool I found for that job was a Stanley Wonder Bar™, which is one of those small handyman-style pry bars that are available almost anywhere that sells tools. Insert the short leg of the bar into the saw cut a couple inches from the end of the joiner pipe. Then rotate the long leg parallel to the pipe. The width of the bar is just about right to spread the joiner pipe to slide over the end of the mast section.

After you have slid the joiner to the mark you made earlier, secure it with a hose clamp. Then use the Wonder Bar to spread the other end of the joiner so you can get the next mast section started.

Once you have the second section slid in against the first, you can install the other two hose clamps (**Photo A**). Be very careful when spreading the joiner pipe. If your spreading tool slips, you could find yourself trying to drive to the emergency room with a foot or two of pipe clamped very painfully to some part of your anatomy. Using this method costs about two dollars per joint, but these joints are strong and reusable while retaining some flexibility (**Photos B** and **C**).

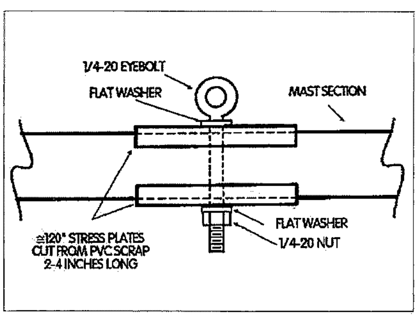


***Fig. 2.** Guy line attachment detail—antenna attachment similar.*

The other method I'm using is a sort of inversion of the one just described. Start by splitting a two-foot length of PVC lengthwise as before, but remove enough additional material so that the joiner can be compressed and slid inside the mast section. Use a hose clamp to compress the first few inches of the joiner. Once the joiner is started into the mast you can move the clamp to facilitate the rest of the operation.

Once you have the joiner inserted halfway, lock it in place with two or three #6 or #8 sheet metal screws. Then you can use the clamp to get the next mast section started. This method is about a buck and a half cheaper per joint than the other and is very strong and flexible. I have a 30-foot mast I built of inch-and-a-half schedule 40 PVC—it has performed very well supporting one end of my G5RV (**Photo D**).

After a particularly nasty ice storm last winter, I was dismayed to find that the inch-and-a-half mast had almost been tied in an overhand knot. Somewhat disheartened, I went out and started knocking the ice off the guys, antenna, and mast. As the weight was removed, I was pleased to see the mast trying to straighten itself. Once the top of the mast was out of my reach a spare mast was used to push the top higher where it finally toggled upright. Since retensioning the guys, the mast has served me well. The three-inch mast at the other end of the antenna has given no trouble despite being guyed only at the top.

Late last winter I woke one morning to find that, overnight, we'd had five inches of very wet snow, the kind that weighs about a metric ton to the shovelful. The antenna was still up and the inch-and-a-half mast was just fine, despite the fact that with the sticky snow,

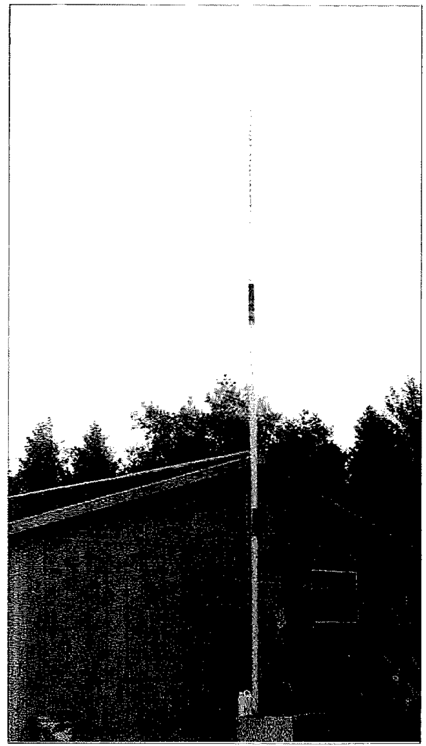


***Photo C.** The three-inch by 30-foot mast at work.*

the guy lines and antenna had grown to almost the diameter of the mast.

PVC pipe is readily available, inexpensive, and durable. If you need a mast for permanent or portable use, you might want to consider the ideas I've presented here. Even if you use three-inch pipe, you can produce a 30-foot mast that is strong, inexpensive, and easy to transport and erect.

Have fun, and be careful out there... 73...

***Photo D.** The 1-1/2-inch by 30-foot mast (photo by Chandra KBØYXB).*

The Silent Killer

Voltage anomalies: out of sight and out of mind—but very real.

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

It's seldom seen, yet it can be one of the most important considerations to address when setting up a ham station, computer operating position or any other expensive electronic installation. It's a transient protection device.

Whether you call them spikes, surges, glitches, or transients, voltage anomalies in the form of high-energy, short-duration pulses can be (and often are) one of the most destructive forms of "gremlins" that can beset the average electronic equipment user.

We often don't even know it. They're usually one of those "silent killers," the ones that inflict their harm without much fanfare or hoopla. They're also very real, and can happen at virtually any time to any one of us. But there is a measure of protection available to even the average amateur, and it probably won't break your budget either.

A hard sell

Security is one of the hardest concepts to sell people—that is, until they've been victimized. That's probably due in part to the tendency we all have of thinking that really bad things only happen to others. And even if catastrophe does strike, we mistakenly think that it can't happen again ... the law of averages and all that. The cold truth is: Misfortune has no memory. We're just as likely to be victims *again* as we were the first time.

Another factor in selling security may also lie in the fact that overstatements seem to abound in the industry itself. Sometimes it's difficult to separate the truth from the hype. You can be pretty certain that you'll only be told what the salespeople want you to hear. And finally, let's face it—protection equipment and devices just aren't very much fun! In the "new toys" department, protection add-ons have probably the very least payback in terms of enjoyment, so we all tend to put them off.

Other dangers

This article will deal primarily with protection devices to guard against those spikes or transients mentioned in the beginning, since they're probably the most common source of destructive "voltage events" that the majority of us will run into. There are others: long-term power line overvoltages, short-term voltage sags, and longer-term brownouts. But generally, these are not the norm for most areas in the US (folks in other parts of the world may not be quite as lucky). Most of the power line problems that we face in our home environments come in the form of those short-duration, high-voltage transients or spikes that we've traditionally associated with thunderstorms and lightning.

Lightning is a major factor. Most people are surprised to learn that there are over eight and a half *million* lightning strikes on the average day—not over your QTH, of course, but somewhere over the globe. That works out to somewhere around 100 strikes per *second*, on average, a frequency considerably greater than the 60Hz power line frequency! It's not nearly as difficult to imagine that there's a federal agency that actually counts them (but I'll bet you already guessed that!).

Voltage transients can enter the commercial power grid from direct lightning hits (usually catastrophic), or by induction from a nearby hit (less spectacular). Either event, of course, can send a spike into your home or mine many times greater than the normal 120V AC power that we expect to inhabit our household wiring [the 120V(RMS) AC sine waves actually have close to 170V peaks, both positive and negative]. In truth, any wire can have a transient induced into it. We often "hear" them on the MF and HF shortwave bands in the form of static crashes, sometimes hefty enough to numb our receivers for a few seconds until the receiver's AGC circuits have had time to recover! Lightning energy extends all the way into the upper VHF frequencies, as evidenced by flashes on our television screens when we watch off-the-air VHF TV.

We know that our antennas should be transient-protected, and perhaps even

disconnected from our station equipment and grounded, when lightning-generating thunderstorms are nearby. But what about other forms of long wires? The telephone lines are a case in point. Telephone lines are certainly "long wires," and they too can pick up transient spikes just as power lines and ham antennas do, transferring that energy into the customer's home and into any customer-installed telephone-line goodies inside. That includes the telephones themselves, FAX machines, amateur radio phone patches, home intercoms (that use the internal telephone wiring for their distribution), and today, our computers, via the telephone modem and serial port.

I've had some personal experience with high-energy transients entering my home via the power lines and the telephone cable; it took way too much of my time, money and energy to put things back to normal after that incident to make me want to go through it again. The only reason that it wasn't actually worse was because I did have an approved protection device across the incoming 240V AC power line, and the internal wiring in my home is pretty well shielded [being inside of grounded thin-wall EMT (conduit) throughout]. Some of my telephone line devices did take it pretty hard, though, and they kept me out of trouble for quite a while, finding all of the problems that were initiated. Only my 2m transceiver and "brick" amplifier (that were on continuous monitoring) were among the casualties in the ham gear category (though they too were eventually repairable), and (fortunately), I didn't have a computer or telephone line modem at the time. I now have considerably more transient protection in-line; once is enough.

The glitch goes on

What's the best approach to protection from voltage spikes and power line glitches? As you've probably already guessed, that question has no simple answer. Much like for other home security, there is a fairly wide range of choices available today. Also, as with other things, you generally get what you're willing to pay for. So perhaps the better way of approaching the matter is to look at what the basic systems consist of, and then look at what you can reasonably expect to get for your investment. You won't end up with complete protection (if that even exists), but if you view it from the standpoint of "whatever I add, it's better than having nothing," you'll probably be being more realistic. And unfortunately, there's no accurate way to test a voltage transient protection system. You'll likely only find out if it's working (and enough) after a nearby lightning strike! Let's hope you never do fully "test" it!

I've talked about transients resulting from lightning, but that's not the only source (though it's usually the most obvious and most deadly one). Motors, pumps, air conditioners, appliances, even fluorescent lighting fixtures, can generate noise pulses (the way we describe transients when we hear them on our ham gear). If those transients are robust enough (and they sometimes can be), they can have a negative effect on sensitive equipment operating from the same power mains lines.

Here's something I ran across recently that I wasn't really aware of in the past: *Even line transients that don't cause catastrophic failures, in some equipment, can erode the device's reliability over time.* How's that again? Semiconductor devices, especially microprocessors and other high-tech, high-speed devices, can suffer gradual deterioration over time from the onslaught of continually being subjected to overvoltage transients—like termites eating away at a structure, little by little, until eventually it gives way.

Apparently, erosion takes place at the junction barriers inside semiconductors in a similar manner. So just because a piece of gear made it through a tough voltage overload or transient, doesn't mean it did it completely unscathed.

This gradual erosion is thought to be responsible for some of the sudden, unexplained equipment failures that I'm sure we've all run into. It can also be responsible for some of the strange happenings that occur only occasionally in some gear: memory loss, hang-ups, etc. At least this is what some researchers currently believe. The obvious solution, of course, is to apply some measure of continual protection against potentially harmful transients. Consider it an insurance policy.

Two approaches

What's available in the transient insurance market? The field roughly boils down to two basic approaches to the problem: parallel mode suppression and series mode suppression/isolation. Let's look at parallel suppression first, since it's the most common approach. Remember, absolute or complete protection may be beyond the reach of the average person—in fact, beyond the boundaries of current suppression technology.

Parallel suppressors

The parallel transient suppression approach consists primarily of installing transient voltage absorbers/bypass devices across the AC line (or telephone line), in the hope that they'll act fast enough, and with enough absorptive power, to trap out, swamp, or shunt to ground the high-voltage spikes on the incoming power mains (see **Fig. 1**) or telephone lines. Electricity travels very quickly, so any parallel suppression device has to operate very quickly—presumably before the transient has had a chance to do any damage.

That may be asking quite a bit. The parallel suppressor must react on the leading edge of the transient's waveform, before it reaches its highest, most destructive potential. MOVs (metal oxide varistors), and other fast-acting solid-state devices, are most often used; many will operate in the low nanosecond (billionth of second) to the picosecond (trillionth of a second) timeframes. How fast they act, and with what level of endurance, is important, because the suppression device has to be able to withstand the full transient "hit" without failing.

Here's another factor to keep in mind. It's also possible for transient suppressors to eventually fail from continually having to dissipate large voltage spikes, resulting in a gradual depletion of their robustness over time. So they shouldn't be looked upon as being permanent. There is, again, no real way to check them for remaining life, so until the industry can give us a better handle on that factor, it's no doubt best to err on the conservative side and replace any suppression devices thought to have taken a hefty hit or two.

Fortunately, there are some standardized specifications for transient suppression equipment today, and it's a good idea to look closely at what you're considering buying. Underwriters Labs® and others have set up standards for rating

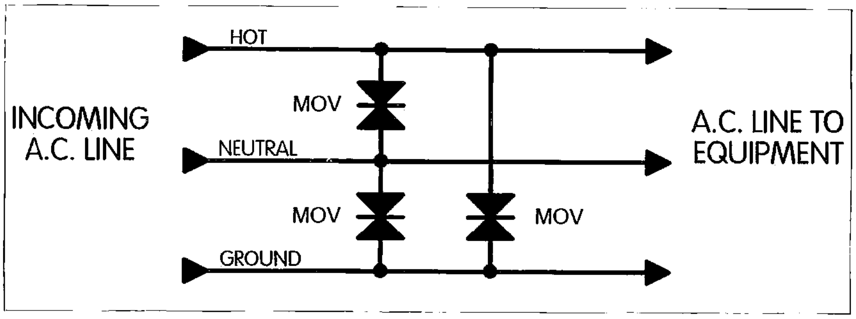


Fig. 1. Typical parallel transient protection utilizing MOVs (metal oxide varistors). Parallel protection depends upon a fast-acting device that will bypass or short the transient to ground before it reaches the protected equipment.

such devices, and any reputable manufacturer should have the test data (to which his device complies) clearly defined on the packaging. It's usually understandable, so you might want to take a look at it.

It's also probably best not to buy anything of this sort used, at hamfests or flea markets, since you'll have no way of knowing what the device has already been through during its lifetime! A protection device that's not going to protect you when you need it is more than just a loss of the money that you paid for it—you'd also have to calculate and add in how much damaged equipment will cost to repair because the device didn't do its job. The final figure could indeed be hefty.

That's why many manufacturers of transient suppression devices also spell out how much they will guarantee in insurance coverage, against damage from covered incidents, when their product is in use. It's called a Connected Equipment Warranty. You may end up having to jump through too many hoops to ever actually collect on the warranty, but it probably indicates that at least the manufacturer has gone through approved testing of the device, just to be able to offer the insurance in the first place. Most of these guarantees only cover the actual cost of repair, not the money lost due to downtime if your computer happens to be essential to your business endeavors. Hopefully, and if you've chosen wisely, you won't be forced into the position of having to collect on it.

The second approach

So far, we've looked only at parallel transient suppressors, and basically how they work in diverting and dissipating power line surges to ground (and/or the neutral wire in the power mains circuit), but there's another school of thought on transient suppression: series mode devices. Series implies that the protective circuitry is in-line (in series) with the protected equipment, effectively isolating the load (your electronic gear) from the mains. Advocates of series-mode protection point out that it may not be a good idea to divert high voltage transients into the ground or neutral wires of the power mains at all, because these diverted spikes can often end up in the signal circuits of the equipment by default.

Why? Because most complex communications and computer setups today use ground as the reference for data and other signals (as in the case of our receiver antenna inputs, for example). Deliberately diverting the transient spikes to this common ground bus could very likely be simply adding to the potential destructive effects of the very spikes and transients that we're trying to get rid of! There's good logic behind that statement.

All ground systems have some resistance and inductance in them. There's no such thing as the perfect conductor in real life ... not yet, anyway. Any voltage drop (transient or otherwise) and any ground loops that exist (almost always), pave the way for many complicated and potentially damaging paths to be set up in a complex modern system. It may be simply spreading the problem to other areas that wouldn't have been affected otherwise—a little like spilling a can of paint, then spreading it around to other non-affected areas in the process of cleaning it up!

The series-mode proponents take a different approach toward keeping the spikes and transients out of the protected equipment. We know from our radio experiences that any series-connected, frequency-selective filter circuit will prevent the passage of energy at the frequencies to which the circuit "looks" like a high impedance. Harmonic filters that are installed in a transmission line are one example; they'll prevent the passage of unwanted harmonics up to the antenna and thus cut down on harmonic radiation from our station.

This is usually accomplished with a classic pi-network filter, an inductor in series and an input and output capacitor (in parallel) to ground. Series-mode transient protectors often take the same approach as shown in **Fig. 2**. An inductor resists the sudden change in voltage through its windings and dissipates energy as heat. Capacitors will bypass a portion of the high frequency energy to ground or neutral, but they also temporarily store some of it and release that energy in a more controlled manner—with less harmful impact.

The result, of course, is that the protected circuitry on the other side of the filter sees only the normal power sine wave and none (or very little) of the transient spike. It's an interesting approach, though quite a bit more expensive to implement than the parallel suppression concept, due to the size and cost of the series components.

The series circuit has to be able to safely pass the normal operating current of all of the protected equipment on the secondary side, along with a measure of overhead current for safety's sake. That requires more costly, heavier-duty parts throughout, as well as a more substantial housing to contain those parts. It's also just possible that whatever transient energy isn't dissipated in the series pi-network could end up going to another branch of your home's AC wiring system to affect something else—similar to the way we usually think in terms of RF energy as "seeing" a high-impedance circuit, and avoiding it. That could impose a negative impact in other branch circuits.

Keeping the objective in focus, however, we see that the series-mode filter probably does protect the equipment that it's supposed to protect more effectively. The components in the series filter are also not as prone to the gradual depreciation over time, as mentioned before, as those in the parallel transient

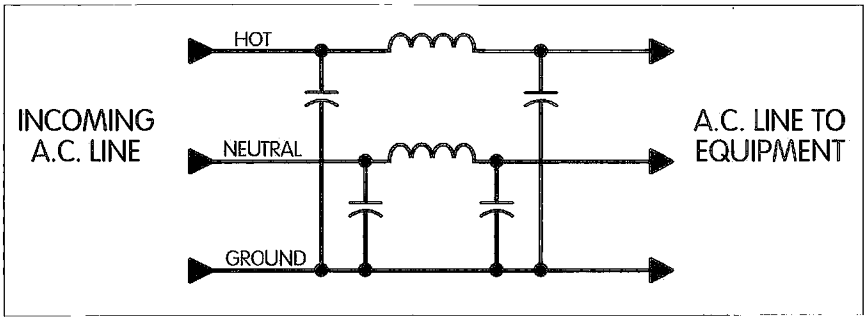


Fig. 2. Typical series transient protection utilizing a pi-network of capacitors and inductors to help to isolate the protected equipment from the transient by either not allowing its passage through the network, or at least greatly reducing its destructive effects.

protection circuits often are, provided that their series ratings aren't exceeded by any sizable amount.

Ground considerations

Finally, here's a possibility that most of us in radio communications probably haven't thought of, yet it's very important to consider. When thunderstorms are in the area, it's possible for very large voltage gradients to occur at different points along the surface of the ground, even over what might seem like a short distance. Remember that lightning bolts between the Earth and clouds create very large currents through the Earth's surface itself (which has resistance and therefore voltage drop).

A lightning bolt is, after all, an attempt by nature to equalize a potential difference between the clouds and the ground. For an instant then, until the ground potential has been allowed to equalize once more, a portion of these potentials can appear across an item of ham gear, for instance!

How? If the antenna ground rod is not directly bonded (via a short heavy cable) to our home's main power ground rod, then the piece of ham equipment will become that direct bond by default, since it's connected to the antenna ground via the transmission line's shield and to the AC mains power ground via the grounding pin on the power cord.

In fact, the revised 1993 National Electric Code has set up requirements for the bonding of all communications antenna grounds, television antenna grounds, and CATV system grounds to the main power ground. The code requires the use of a number 6 (minimum) copper bonding conductor (flat 1-1/2-inch-wide copper strapping is even better) between any separate ground rods, and the main power grounding rod, to avoid inadvertent large potential differences across an in-home appliance during lightning storms.

It's thought by some in the field of lightning protection that this route alone may be responsible for more lightning transient damage than any other means of entry. It makes sense and it's something to look at very seriously.

Continued

What To Look For

Even though the market in surge and transient protection hardware is complex, with many brands and models competing with one another for your attention, it is navigable. Underwriters Laboratories' *UL 1449* describes the testing and specifications that manufacturers must follow for parallel-mode surge suppressors in order to claim *UL 1449* compliance. If you have access to the Internet, there's a wealth of information for the asking (perhaps even more than you'll want to know) by using the keyword "UL 1449" in your favorite search engine. By the way, *UL 1449* covers several categories of testing, so all 1449-compliant suppressors don't necessarily have exactly the same specifications. You still have to read the specs and compare.

Here are some points that you might consider in comparing suppressor units:

•*Test clamping voltage:* Test results listed under the lowest test clamping voltage will give you greater protection. Suppressor specifications can be gathered under several clamping voltage levels and still be UL 1449-compliant.

•*Maximum surge dissipation rating in joules:* The larger the rating in joules, the more robust the unit will be.

•*Maximum surge suppression in amps:* the higher, the better.

•*Response time:* The closer to zero nanoseconds, the better.

•*Maximum spike protection voltage:* The higher, the better.

•Does the unit have *RJ11 modular jacks* (the standard telephone company modular jacks) built into it, for inputting and outputting to and from your computer modem or FAX machine, to protect it as well? Buying a separate suppressor for your modem, FAX, or other telephone-line-connected equipment is generally more expensive than buying a unit that already has this feature built in.

•Does the unit have a fast-acting *catastrophic surge fuse* built in as well? It's better if it does—the fuse will help to protect the protector.

•Are there *enough outlets* on the unit to power everything you'll need to power? Are all of the outlets protected? Is the power cord on the unit long enough? You could add a separate outlet strip, but that's added expense and clutter.

•Does it have *status lights* to let you know when there's a problem with the unit itself? If it doesn't, how would you ever know if it isn't all right?

•Will it *handle your expected current or wattage demands?*

•Does it have any *EMI/RFI filtering* built into it? Some do, some don't, but that may be an important factor, especially in a ham shack environment. If it does, how many dB down will the RF be over a specified frequency range (such as: -40dB from 150kHz to 20MHz)?

Each of these items will add some expense to any transient suppression unit, but if you do your homework carefully, you'll probably find some models that have more of what's desirable, for the same or less outlay, than other models.

The market is constantly changing, so what your buddy bought last year may not be the best deal for the money this year. You'll have to educate yourself, to some degree, in order to maximize your purchasing dollar against your value received.

Incidentally, there's a whole lot more good information coming up soon in my "Ham To Ham" column, here in *73 Magazine,* on the subject of lightning protection for our ham station installations. It will be in the form of an ongoing monthly series (for several months running), and was put together by a pair of experts in the field of commercial radio transmitting station lightning protection ... watch for it!

As you no doubt can see, the playing field for adequate transient protection is still a little muddied, each school of thought promoting its own advantages and pointing out the shortcomings of the other. Perhaps the real answer lies in a mix of the two technologies ... or maybe in some new technology. New ideas and products are being tested every day.

The bottom line seems to be that we've not seen the one cure-all yet, which is why it's impossible to recommend any single approach as the final answer in every case. But don't let that discourage you from implementing some form of transient protection right now. The way I see it, for my own equipment, I'd rather have *some* protection than none at all, even if it isn't absolutely perfect in all possible scenarios. Few things in life offer complete protection. Come to think of it, I remember hearing somewhere that the only guarantee is that there are no guarantees! 73

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

World's Fastest Code Course

73T05 **Genesis 5 wpm code tape** This beginning tape takes you through the 26 letters, 10 numbers and necessary punctuation complete with practice every step of the way. $7.00

73T06 **The Stickler 6 wpm code tape** This is the practice tape for those who survived the 5 wpm tape and it is also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are sent at 13 wpm and spaced at 5 wpm $7.00

73T13 **Back Breaker 13 wpm code tape** Code groups again at a brisk 13+ wpm so you'll be really at ease when you sit down in front of a steely-eyed volunteer examiner who starts sending you plain language code at only 13 per. $7.00

73T20 **Courageous 20+ wpm code tape** Go for the Extra class license. $5.95

73T25 **Mind Boggier 25+ wpm code tape.** $7.00

73 Review

Small Wonder Labs' GM-30 Transceiver Kit

Build it for under $100!

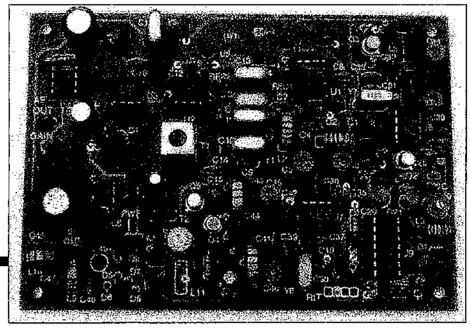


Photo A. Stuffed PC board.

Jeff M. Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

It really seems amazing to me that, for less than a hundred dollars, you can put together a transceiver that will allow you to talk to people all over the world. And not only can you do this fantastic feat, but the receiver sounds about as good as the expensive commercial rigs.

Not too many years ago, if you wanted to use a radio you built yourself, you might start by building a transmitter, and then a separate receiver. This approach had the advantage of allowing you to learn how simple circuits work, and maybe even how to read a schematic. The down side was that when you were finished building, you were going to have to really work to make contacts.

Many of the earlier kits were crystal-controlled. This meant that you were stuck on a single frequency, or maybe if you built a VXO (variable crystal oscillator), you could change to very close frequencies. You also had to switch manually between transmit and receive, or build additional switching circuitry.

Most of the kits currently on the market are full transceiver kits with solid state transmit/receive switching. They have superheterodyne receivers and other desirable features. The truly amazing fact is that the vast majority of kits are being manufactured by small companies. Ten-Tec has recently started building kits and now offers a low power (QRP) transceiver kit.

There are two overall qualities on which I judge a kit: The first is how much fun it is to put the kit together. Quality of parts, lack of ambiguity in instructions, and completeness of instructions are all important aspects of the building experience.

The second quality, how well the rig performs on the air, is also very important. The receiver performance, transmit/receive changeover, sidetone, and "feel" of the rig contribute to its performance. I want to be able to hear weak signals, separate out signals that are close together, enjoy listening to the sound of the rig, and know that when I think I am right on a station's signal and transmit, both the other person and I are on the same frequency.

The bottom line on the Small Wonder Labs Green Mountain (GM) 30-meter kit is that I had fun building it, and even more fun operating it. I am amazed each time I turn on the rig, which I power with a small gel cell. I use a Gap vertical antenna with an LDG AT-11 autotuner in order to get it to work on 30 meters. I have checked a number of times, and if I can hear a signal on my Kenwood TS-930, I can hear it on my GM-30. I have operated it with no problems during times of high atmospheric noise and times of crowded conditions.

The design

Dave Benson NN1G was the designer. His original project, the NN1G, was a twenty-meter transceiver that put out about 1.5 watts. The project design appeared in the 1995 *ARRL Handbook.* The GM series is an improved version of the SW transceiver series. The SW series of transceiver kits is what got Dave to give up his day job and spend full time in the "lab."

The SW series was first introduced by the New England QRP Club in 1994 as the "40-40." The transceiver was designed to be a compact, low-cost, superhet kit that would be sold just as a board and its parts. The builder would provide a case and connectors. This project was covered in the November 1994 issue of *QST* and various other QRP publications.

The main design feature of the GM series is an improved heterodyne local oscillator. This part of the circuit was designed with extra complexity to provide improved performance on the high bands. It employs a Colpitts oscillator that runs at approximately 3.8 MHz and is then mixed with a crystal-controlled oscillator running at 14.318 MHz. The output is then bandpass-filtered to yield the desired 18.1 MHz injection frequency.

The front-end filtering uses a pair of tuned circuits. This is a more complex arrangement than in the predecessors, but yields a lot better image rejection performance. The T/R switch also uses a series of resonant tuned circuits to further improve the passband filtering. The audio output stage uses the 8-pin version

of the LM380, which is rated at 0.6 watts output, to improve audio quality.

I really like the way the rigs sound. The LM380 draws a little more current than the usual LM386, but provides better audio quality. The radio also has RIT with an on/off switch. I find the RIT very useful on 30 meters.

For QSK, the audio frequency mute function is done by an FET switch. In the "key-up" condition, the FET is "zero-biased" and acts like a resistance of several hundred ohms. In the "key-down" condition, the FET is in cutoff and acts like an open circuit, preventing audio from getting to the audio final stage. The rig has a pleasant sidetone.

The kit

The printed circuit board is commercial-quality double-sided stock, solder-masked and silk-screened. The board is compact in size (three and a half inches by five inches). Parts are all high quality, and my kit did not have any missing parts.

The manual is excellent. It is printed on quality paper with very high quality laser printing. The manual starts with basic information for you to be familiar with before you start to work on the kit. It clarifies what soldering iron to use and parts identification, what is meant by a turn in winding a toroid, and other essential information. I highly recommend reading *all* of the material before starting.

I've built a number of kits. The only problem (and it was a small one) I had with building this kit was caused by not reading the directions. I should know better by now.

Please make sure you read the note about capacitors on the bottom right of page 3 of the manual. It is important to put the right type of capacitors in the LO section. It is quite easy to place the correct value, wrong type.

A further note of caution: As I mentioned, the board is very high quality, double-sided and with plated-through holes. This makes for a very good radio when you are done, but it also makes it hard to unsolder if you make mistakes. I found that desoldering braid was the only effective way to get parts off. I sometimes used my Radio Shack™ "solder-sucker," but had much better results with the wick. It is much easier to put the parts in the correct place the first time. I checked all resistors with a meter before installing them on the board.

I don't consider this kit to be a true beginner's kit. I want to clarify this because I do believe a beginner can build this kit and get it working the first time. There are only three pages of building instructions. There are twelve toroids to wind. They are easy to wind, but some beginners don't like to do this.

There is a recommended assembly sequence, but no part-by-part checkoff. You can request a step-by-step building list that was written by Chuck Adams K5FO. I checked out his instructions and they worked very well. The sheets describe the parts and give the color codes of the resistors. This made it much easier for me in parts picking and placement.

The diagrams and schematics in the manual are all excellent. The schematics have voltage measurements in order to troubleshoot, if necessary. I found that although the silk screen on the board has the parts identifications, it was not exactly clear in some places which parts went where. This was not a problem, as there is an oversized blowup of the parts placement included. I ripped it out of the manual and used it. I did not have any problems using the diagram to find parts placements. Some parts of the board are fairly densely populated. This isn't much of a problem either, but I think a first-timer or beginner might want to be aware of this.

The kit is a boards-and-parts-only kit. Small Wonder Labs gives the name of a company from which you can directly buy a black-anodized extrusion enclosure, or it will provide an enclosure at extra cost upon request (ask Small Wonder about price). There are also no plugs or jacks included.

For many builders, this scheme is a real plus. This allows Small Wonder Labs to sell the kit for $75. Many hams already have a wide assortment of connectors and cabinets. I used a small computer A/B switchbox for an enclosure and had many of the connectors in my parts boxes. I spent only another six dollars.

I don't like headphones, so I always put in small speakers. I used an eight-ohm, two-inch Radio Shack speaker (about $3, but you can get them at hamfests for $1 or less). There are no jumpers on the board and all controls are connected through provided 0.100-inch gold-plated headers. The kit provides pre-assembled connector harnesses. I found the harnesses made it much easier for me to do the final wiring.

First things first

The first section you build is the heterodyne LO. After you build it, you align it. The best way to do this is to use an oscilloscope. You attach the scope and adjust two trimmer capacitors for maximum amplitude. If you don't have a scope, Small Wonder Labs includes an extra envelope of parts that allows you to build a test circuit. Using this circuit, you need only a multimeter to align the oscillator. You next adjust the frequency. The recommended piece of equipment for this is a frequency counter. If you don't have a counter, the directions explain how to use a general coverage receiver or ham band transceiver to do this job.

You then finish building the rest of the kit. After getting the parts on the board, you align the receiver. This involves adjusting an IF transformer (mine had a very sharp peak), then three other trimmer caps. You adjust for maximum atmospheric noise. This was very easy to do and took only a couple of minutes.

To align the transmitter, you make sure you have a 50-ohm dummy load attached, and you can use either an oscilloscope or wattmeter capable of measuring QRP levels. For the first tune-up, I used my wattmeter in order to get the rig on the air. There are two trimmer caps you tune for maximum signal strength. I checked the radio the next day using my scope and found I had adjusted the transmitter correctly and was getting very clean output. There is a pot for adjusting power. I adjusted mine just below full clockwise while observing the waveform on my scope in order to get peak efficiency, as suggested in the manual.

The manual contains a section on troubleshooting both the transmitter and receiver. If you still have trouble and can't find the problem using the information on the schematic, you can contact Dave Benson by mail, phone, or E-mail. I have noted that hams on the QRP Internet mailing list report good results getting help from Dave. I have had

excellent results contacting him and getting quick responses. If all else fails, troubleshooting/alignment is available at a reasonable flat-rate fee.

On the air

I had a great time putting this rig together. All the parts in the kit were good quality, and building and aligning were straightforward.

I usually go through a period of anxiety doing the "smoke test." I had already aligned the oscillator, and felt very confident when I powered up the rig. The radio worked the first time. The time between completion and aligning and testing was very short. I chose not to put the rig on the air until I had it in the case. I had prepared the case before finishing the alignment in order to minimize my usual propensity for messing things up at the last minute (like putting a finished board on the work bench and having a stray metal wire short something out).

I have to admit doing my own cases is my least favorite part of building. The case I used was made of steel. I managed to break a drill bit in making my holes, but I got the case ready to go with all the case wiring done. I put the board in the case and attached the two ground wires to the board.

I brought the rig over to my bench and hooked up the antenna, key, and power. I tuned my Gap vertical to 30 meters and was raring to go. I searched around the band. The band did not appear to be in great shape. I heard Frank KD2IX calling CQ. I answered and we had a good QSO. He was in Carmel NY and also QRP. I took this as a great sign, because I really enjoy QRP/QRP contacts. I next worked Dick W6OV in Nebraska. Next, I worked another QRPer in Tucson AZ.

I spent quite a bit of time all weekend testing out the new rig. During the evening I worked Karel OK2FD, in the Czech Republic. By the end of the weekend, during very bad and not-so-good conditions, I worked all over the United States and some DX—all with a small gel cell battery and a Gap vertical antenna. The Gap wasn't even designed for 30 meters, so I had to use my LDG-11 auto tuner for 30.

I found the receiver to be very quiet. It is also quite sensitive and selective. I could hear about anything that was out there, and was easily able to tune to signals and separate them out. The VFO seems very stable. The sidetone was pleasant to listen to and I really enjoy the audio quality of receive signals. The QSK works great. I get about two watts and don't intend to do anything to change the way the radio is working. I really enjoy operating this little rig. It's already one of my favorites. In comparing it to the large number of rigs I have built, it comes out at the top of the list. The VFO easily covers the whole 30-meter band.

I would recommend this kit to anyone. If you are a beginner and can get some help, go for it. Experienced hams will really enjoy both building and operating this kit.

For further information, contact Dave Benson NN1G, Small Wonder Labs, 80 East Robbins Ave., Newington CT 06111; (860) 667-3536; [bensondj@aol.com].

NEVER SAY DIE

Continued from page 5

civilian deaths in other wars such as the Spanish Civil War, the Italian invasion of Ethiopia, India-Pakistan's two wars, the Korean "police action," Nigerian war, Vietnam, Iraq-Iran, and so on.

Zbig estimates that wars have extinguished at least 87,000,000 lives in this century.

Additionally, Hitler had about 17,000,000 people put to death. Lenin is credited with about 8,000,000 and Stalin, who did his best to wipe out the Russian intelligentsia, managed about 25,000,000 ... teachers, military officers, and so on. This brings the total to about 175,000,000 killed. That's about two-thirds of the population of the US, and the killing is still going on in a bunch of countries.

In view of the massive massacres that have been going on all around us I can understand why so few people seem to care about cigarettes prematurely killing an estimated 400,000 Americans a year, or hospitals killing 300,000 a year as a result of errors. Heck, we probably have about 3,000,000 Americans dying every year as a result of poisoning or poor nutrition, and we never even blink. With some attention to healthy nutrition and an end to legalized poisoning, we'd have around a million fewer deaths every year. Of course that would raise hob with Social Security, our medical industry and insurance companies, so never mind. Let's forget the whole thing.

Those Pesky Crop Circles

Yes, I saw the TV program showing the two British farmers making crop circles with boards. But I also saw a program where investigators had set up cameras to try and catch the circle makers in the act. They showed a large pattern in a hay field being formed in seconds. Further, a close inspection of the hay showed that, unlike the fake circles, where the hay was broken, the

Continued on page 49

SOS ... SOS ... *Titanic!*

Radio operators' courage still inspires amateurs.

Mario Garcia
534 Travis
Port Lavaca TX 77979

In 1910, the government required all ships to have a wireless telegraph. Yet by 1912, fewer than 400 ships were equipped with Marconi wireless. It was the *Titanic* disaster, just off the coast of St. John's, Newfoundland, which finally proved the value of wireless to the world. This article is about the *Titanic*'s fateful day and the two wireless operators, John Phillips and Harold Bride, who performed their duties with valor and honor.

Hard work

Working on the *Titanic* was serious business and hard work for senior telegraphist John George Phillips, 24, and junior telegraphist Harold Sidney Bride, 22. Although signed on with the crew as telegraphists, the two men were actually employees of Marconi International Marine Communications Company, Ltd. Ship-to-shore wireless transmission was in its infancy and viewed more as a convenience than an integral part of the ship's command. The operators were under the captain's command, but only with regard to receiving and transmitting messages of importance to the ship. Their main job was taking care of the passengers' telegrams while at sea. The ship's weather reports and ship-to-ship telegrams came second, as they weren't paying customers. Under its agreement with the Marconi Company, the White Star Line, owner of the *Titanic*, was provided with free wireless messages between the ship and its owners or other ships regarding navigation, safety, or the ship's business, provided the messages did not exceed a 30-words-per-day average. Excess words were charged to the ship's owner at half the usual tariff rates. In return, White Star was to provide the Marconi operators with their meals and lodging. The Marconi Company, in turn, paid John Phillips and Harold Bride approximately $23 per month and $12 per month, respectively.

The fateful Sunday

On Sunday, 14 April, 1912, Phillips and Bride had been busy receiving, logging, and transmitting passenger messages. Wireless transmitting and receiving ranges increased markedly at night, and night signals from the powerful British land station at Poldhu (call letters MPD) relayed by intermediate ships had included news, stock reports, and some personal messages. There had been daily traffic messages to and from *Titanic*'s passengers. The ship's 1.5-kilowatt wireless transmitter, among the most powerful afloat, had a 400-mile daytime transmitting range. This range increased significantly at night, but during the day, particularly now in the North Atlantic, its functions were limited to ship-to-ship messages.

Signals were transmitted and received on closely adjacent standard frequencies, with two, three, or even more signals being sent or received at the same time. Much of the operator's skill involved being able to discriminate and select the particular messages addressed to his station. To assist operators, each station had its particular identifying call letters. With few exceptions, call letters from British ships generally began with M, while those of German ships started with D, and United States naval vessels with N. *Titanic*'s call letters were MGY.

The long hours and tedious work made the job very stressful for Phillips and Bride, but fortunately for them they would work in shifts to help each other at the Morse key. In 1912, laws did not require two operators or 24-hour watches on the ship's wireless. Many passenger liners and all freighters had single wireless operators who rested or slept when they could.

Ice!

Wireless operators were supposed to intercept for their captain's attention all messages relating to the navigation and safety of his vessel. Phillips and Bride received several messages concerning ice conditions in an area toward which the *Titanic* was directly heading. At 9:00 a.m., a message from the *Caronia* was taken immediately to the bridge, where it was posted for the officers' attention. Another message was received from *Athinai* via the *Baltic:*

Captain Smith, Titanic
Greek steamer Athinai reports passing

icebergs and large flotation of ice field today.

This message placed icebergs within a few miles of *Titanic*'s track. It was taken to Captain Smith. The message was not posted on the bridge nor entered in the scrap log until 7:15 p.m.

As daylight turned to dark, the cool air began to turn cold. At 7:00 p.m., it was 43 degrees. Because of the day's wireless messages, an iceberg watch was ordered. By 7:30 p.m., atmospheric temperature had dropped to 39 degrees.

At this time a message from the *Californian* to the eastbound freighter *Antillian* was overheard by the *Titanic*'s wireless operators. Harold Bride delivered the message to the bridge and handed it to an officer. The *Californian* message reported ice about 18 miles north of *Titanic*'s track. By 8:40 p.m., the air had fallen to 35 degrees as the *Titanic* steamed full ahead at 21 knots. Around 8:50 p.m., Captain Smith was briefed by his officers about weather conditions and the ice and about the precautions that had already been taken.

More warning

It was 9:40 p.m., and in the wireless shack Harold Bride had turned in for a nap before working the busy late-night traffic. John Phillips was manning the transmitter alone when a message was received from the westbound *Mesaba:*

To Titanic and eastbound ships:
Ice reports. Saw much heavy pack ice and great number large icebergs.
Also field ice. Weather good, clear.

The land station at Cape Race, Newfoundland (call letters MCE), was in range now and John Phillips was very busy transmitting messages which had accumulated during the day. Unable or unwilling to leave his key unattended, he ignored the *Mesaba*'s ice message which described ice directly ahead for *Titanic.*

The message never did get to the bridge. With lights from the ship's decks seemingly guiding the way, *Titanic* sped with determination through the night at 21 knots. The sea was so calm that one officer on the bridge made the comment that in all his years on the sea he had never seen it so flat. The stars shone brightly in the moonless sky.

As 10:30 p.m. approached, the steamer *Rappahannock*, passing on an opposite course, signaled the *Titanic* with its Morse lamp:

Have just passed through heavy field ice and several icebergs.

Titanic replied by signal light:

Message received. Thanks. Good night.

Titanic continued on her course, speed undiminished. In the wireless room, John Phillips was very busy with Cape Race traffic as well as sending and receiving messages to and from other ships. A few minutes before 11:00 p.m. he was interrupted by a very strong signal from a nearby ship, the freighter *Californian*, twenty or so miles away to the north:

I say old man we're stopped and surrounded by ice.

She was so close that she almost blasted Phillips' ears off. Annoyed by the intrusion interrupting his traffic, John Phillips curtly responded:

Shut up. Shut up. I am busy. I am working Cape Race.

Californian's wireless operator, Cyril Evans, rebuffed by John Phillips' curt message, listened for several more minutes to Cape Race traffic. Then, around 11:30 p.m., he turned off his equipment and turned in.

Doomed

On the *Titanic*, two crewmen in the crow's-nest swung their arms in an effort to keep warm in the freezing air. Their eyes strained into the night's darkness ahead. They had wished they had their binoculars to help them see better. Somehow, the binoculars had been misplaced the day before.

Suddenly, without a word, one of the crewmen hunched forward and peered intently into the black, moonless night. He immediately reached for the bell lanyard and gave three sharp pulls to signal an alarm. He then picked up the phone piece and called the bridge: "Iceberg right ahead."

The warning was too late. The officers in the bridge stopped and reversed engines and averted a head-on collision with a large iceberg, but the huge iceberg managed to strike a glancing blow on the *Titanic* fifteen feet above her keel. The gash extended for 300 feet along her side, flooding five of her compartments. The *Titanic* was designed to float with three or four flooded compartments, but not five. She was doomed.

***Carpathia* to the rescue**

By 12:05 a.m., the *Titanic*'s front compartments were rapidly filling with water and all engines were stopped. Captain Smith, realizing the ship was sinking, personally went to the wireless room and instructed the wireless operators to order a call for assistance. "You had better get assistance," Captain Smith told his wireless operators.

John Phillips set the frequency on the multiple tuner to 600 meters, adjusted the spark gap for maximum range, and sent out the standard CQD distress call (some operators called it Come Quick, Danger) from *Titanic*'s huge antenna. Later that night, Harold Bride decided to use the new distress signal, SOS, which was just coming into use. *Titanic*'s wireless operators sent one of the first SOSs from a ship in distress:

SOSSOSCQDCQD—MGY.

This was a call for help to save over 2,200 lives on a ship that only had enough lifeboats to save 1,178.

By 12:45 a.m., several ships and land stations had responded to Harold Bride's and John Phillips' distress calls. The *Carpathia* was 58 miles from the *Titanic* at the time of collision and responded immediately. *Carpathia*'s captain turned his ship around and raced to the rescue.

Opportunity lost

Although the *Carpathia* was close to the distressed *Titanic*, there was another ship that was much closer—but it never heard the *Titanic*'s wireless distress calls. The wireless operator on the *Californian* had turned off his wireless and gone to bed after John Phillips had told him not to interfere with his commercial traffic. The *Californian* could have saved the lives of all the *Titanic*'s passengers if only the operator had not shut

off his wireless and turned in for much-needed sleep.

Abandon ship!

On the *Titanic*, Captain Smith ordered loading of the lifeboats with women and children first. By 1:30 a.m., *Titanic*'s bow was distinctly down and she listed heavily to port. The slant of the ship's deck was becoming steeper and people were having trouble keeping their balance as they moved toward the stern. Lifeboats were being lowered into the calm sea 60 feet below the ship's deck. Although the lifeboats were capable of carrying 65 passengers, some boats were filled with fewer than 20 people.

Signs of panic began to appear. In the wireless shack, John Phillips and Harold Bride were still at their posts, their distress calls becoming increasingly desperate:

Engine room getting flooded.

At 1:45, another distress call:

Engine room full up to boilers.

Every man for himself

By 2:05 a.m., most of the lifeboats had been lowered (except for the collapsibles) and had moved away from the *Titanic*. More than 1,500 people still remained aboard. With the boats all gone, hundreds of passengers left behind stood quietly on the upper decks. A quiet calmness set in. Captain Smith made his way to the wireless room and told John Phillips and Harold Bride that they had done their duty. Now it was every man for himself.

Into the sea

As the ocean water filled one compartment after another, the water's weight pulled the *Titanic*'s bow completely under. The great ship's immense bulk started a catastrophic arc into the star-filled sky. As the *Titanic* upended, hundreds and hundreds of people were thrown into the sea. The water temperature of the North Atlantic was about 28 degrees Fahrenheit. As energy from the generators faltered, the last wireless signal spluttered to a halt.

At 2:20 a.m., the liner started its nearly vertical descent downward into the sea. Not yet completely under the surface, with a load roar the sinking hull broke in two near an expansion joint and engine room shaft. The forward section of the ship began its drop to the ocean floor over two miles below, while the stern section remained afloat a few seconds more before it, too, plummeted to the bottom.

Down with the ship

Almost immediately, the silent night was filled with the calls of floating survivors, growing in number until there was almost a continuous wailing chant. Hundreds of people cried for help as they struggled in the icy cold water. Some of the ship's 1,500 passengers managed to reach some of the lifeboats, but most did not. Long before dawn, hypothermia had claimed the lives of most of the floating survivors. The rescue ship, *Carpathia*, arrived around 4:00 a.m. and started to take on survivors from the lifeboats that held mostly women and children. Everyone was still in shock, not only from the horrendous experience they had just witnessed, but also from the bitter cold that engulfed them. In all, 711 passengers survived the ordeal. Captain Smith did not survive. He went down with his ship.

Constant duty

Of the two wireless operators on the *Titanic*, only Harold Bride survived the tragedy. Even after his subsequent rescue by the *Carpathia*, he continued to perform his duties as a wireless operator. The ship already had a wireless operator named Harold Cottam, but he had not slept for many hours and was totally exhausted. Bride had to be carried from the dispensary, where he was treated for severely frostbitten feet, to the wireless room where the exhausted Cottam was working. Once Bride began to transmit, Cottam got a few hours of precious sleep. Both Cottam and Bride ignored all information requests from private and public sources even as the *Carpathia* sailed full steam to America.

Once the *Carpathia* reached New York, Bride was carried ashore on the shoulders of two *Carpathia* officers. Among the last of the survivors to be brought ashore, Bride had been almost constantly on duty since boarding the ship from an overturned collapsible boat and now, totally exhausted, he was taken to a nearby hospital for treatment of crushed and frostbitten feet.

Inquiry

At the *Titanic* inquiry, several proposals were made:

1. Lifeboats required to have increased capacity, a seat for each person aboard, and adequate manning.
2. Wireless stations required to have 24-hour manning.
3. Amateur interference banned.
4. All ships required to provide reliable auxiliary power sources.
5. Wireless operators required to maintain secrecy of all messages.

These wireless recommendations resulted in the Radio Act of 1912, which required all ships to carry wireless stations. The Act also contributed to the Marconi Company's extraordinary financial success.

"The last I ever saw of him ..."

The wireless operators of the *Titanic*, John G. Phillips and Harold Bride, went into the history books as two young men who heroically stood at their post, bravely transmitting distress signals until moments before the huge ship sank. John Phillips' body was never recovered. Harold Bride said of his coworker, "Phillips ran aft and that was the last I ever saw of him."

Harold Bride kept a very low profile in the years following the *Titanic* disaster. World War I found him as a wireless operator aboard the steamer, *Mona's Isle*. Later in life he became a salesman before returning to Scotland, where he died in 1956.

Bibliography

Dr. Robert D. Ballard, *The Discovery of the Titanic*, Warner/Madison Press, New York, 1987.

John P. Eaton & Charles A. Haas, *Titanic: Destination Disaster*, W. W. Norton and Company, New York-London, 1987.

John P. Eaton & Charles A. Haas, *Titanic: Triumph and Tragedy*, W. W. Norton & Company, New York-London, 1986.

Walter Lord, *The Night Lives On*, William Morrow & Company, Inc., New York, 1986.

Which Band's Best for QRP?

Some are better than others for low-power operation.

J. Frank Brumbaugh W4LJD
P.O. Box 30 - c/o Defendini
Salinas PR 00751-0030

Doing more with less—using no more than five watts PEP—has made CW the preferred mode for QRP. CW signals are narrow, putting all five watts into a bandwidth only a few Hz wide, which enables the use of narrow filters in receivers. This fact alone provides the "oomph" that allows worldwide QSOs when conditions are good.

When I received my first General Class license in 1949—it was called "Class B" then—there was no 15 meter band, and 40 meters was CW only. Times have changed; phone proliferated, especially SSB, and various digital modes became available, necessitating changes in the band plans, squeezing CW into narrower and narrower segments, further aggravated by "Incentive Licensing" which took most hams out of the lower 25 kHz of most of the HF bands. However, this was not all bad, because it tended to concentrate most of the QRO DX-chasers into that 25 kHz segment, eliminating a lot of QRM in the rest of the CW segments.

The 40m band has long been the all-time favorite band for most hams, especially when using CW. It provided QSOs with almost every CQ. Many were with other US hams, but at night the band provided DX with good signals. Best of all, conditions were pretty much the same regardless of the solar cycle. The band hasn't changed, but occupancy has. Of course, QRP has little chance in the QRO-dominated bottom 25 kHz. Digital extends down to 7.070 and often slips as low as 7.060. Worse, foreign SSB can often be heard as low as 7.035, effectively leaving just 10 kHz for CW at night. This band has the most crowded CW segment of any HF band, and QRM is extremely high. It is no longer the best all-around band for CW, especially QRP.

The low bands, 80 and 160 meters, are usually very noisy, and useful antennas require more real estate than most hams have available. These bands are usually useful only at night because of high D-layer absorption and thunderstorm static during the days.

Blame it on Ol' Sol

The 20m band, long considered the DX workhorse band, is still that, of course. It is an excellent band for QRP CW operation, and there is plenty of DX to be found, both rare and ordinary. The QRO DXers stay mostly in the lower 25 kHz, and digital extends down only to 14.070, leaving a span of 45 kHz for CW. Right now this band is open primarily during daylight hours, closing shortly after sunset. In a few years it will open earlier and close much later, sometimes remaining open all night.

Thirty meters is probably the best all-around band for QRP CW, regardless of the time of day, year or sunspot cycle. There is very little variation in propagation conditions over time on this band. D-layer absorption is very low, much lower than on 40m and below, and the daytime distances workable are higher as well. Thirty meters is always open to somewhere in the world, with nights providing most of the DX. Because the maximum power allowed on this band is only 200 watts PEP, your five-watt signal is only 16 dB down, about 2-1/2 S-units, so there are no "California Kilowatts" to drown out the peanut whistles.

Thirty meters is only 50 kHz wide, and the lower 30 kHz are CW only. Most DX will be found between 10.100 and 10.115, with rag-chews and casual QSOs from there to 10.130, where digital modes have the upper 20 kHz. There is no ham SSB allowed on this band. Occasionally but rarely, the MUF may fall below 10 MHz on some DX paths at night, but other paths are apt to be open. This condition can only occur around the lowest point in the solar cycle. Antennas for the 20 and 30m bands are much smaller than for 40m, and thus are easier to hide where this is necessary or desirable.

The increasing number of capable, inexpensive, monoband transceivers, in both commercial and kit form, is

indicative of the growing interest in the challenge and fun of QRP operation. Most of these transceivers are CW only, and single band, but some also provide for SSB operation, and a few are multiband rigs. RF output, which depends upon the particular transceiver, will be from one to more than five watts PEP, and most, if not all, allow easy power reduction into the milliwatt range of power output.

"When 10 meters is open, you can hear two wires being scraped together on the other side of the world!"

Most of these rigs are easy to take along on trips or camping, and their generally low current requirements make battery operation easy. For sensitivity and selectivity, they are equal to pricier equipment. Of course, there are few, if any, bells and whistles added—these are basic radios intended to be used for communications—but most of the extra features provided on the big-bucks rigs are seldom used in normal operation. You don't need them to have lots of interesting and enjoyable QSOs!

So, tune around the bands, noting what you hear and where the signals are coming from. Do this for a few days, and also for a few nights, to get a better "feel" for the band. Tune especially around the internationally recognized QRP calling frequencies.

For CW, these are, in MHz: 1.810, 1.843 (Europe), 3.560, 7.040, 7.030 (Europe), 10.106, 21.060, 28.060.

For QRP SSB: 1.910, 3.985, 7.285, 14.285, 21.385, 28.385. There are not yet established calling frequencies on 17 and 12 meters.

Pick a band you like, and if you have a loaded multi-kilobuck rig, crank the power down to no more than five watts PEP and make a few QSOs. If you lack such a big rig, order one of the many QRP transceiver kits, put it together in an evening or two and get on the air. You are guaranteed to enjoy yourself. If you don't hear anyone, call CQ on the calling frequency. There is likely another QRPer tuning and listening. Accept the challenge of "doing it with less," and above all, have fun! 73

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January 1998 issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event.

OCT 4

BELTON, TX The Temple ARC Ham Expo will present a "Fall 'Fest" at the Bell County Expo Center, starting at 8 a.m. Admission $1.00. Handicap accessible. Indoor tailgate arena, spaces $10 at the door. Tailgate setup begins at 6 a.m.; free electricity. Tables $10 each (only at the door). Commercial vendor spaces with tables, $20 each, or with Fri. night early setup, $25 each (reserve by Sept. 22); free electricity. Send deliveries to 1802 S. 13th St., Temple TX 76504. Write to *Temple ARC, P.O. Box 616, Temple TX 76503;* or call *Mike LeFan WA5EQQ, (254) 773-3590. E-mail [mlefan@vvm.com]. Expo netpage [http://www.tarc.org].* Talk-in on 146.820 MHz, pl 123.0 Hz.

TEANECK, NJ Bergen ARA will hold its annual Fall Hamfest at Fairleigh Dickinson University. Buyer admission $3, with XYLs and harmonics free. Seller admission $10. Special features include plenty of parking, and VE exams. Take Rte. 4 east/west to the River Road exit. Follow the signs into the hamfest area. Talk-in on 146.790(-600). For more info, call *Jim Joyce K2ZO at (201) 664-6725, before 10 p.m.*

WARRINGTON, PA From 8:30 a.m.–9 p.m., the Mt. Airy VHF Radio Club (Pack Rats) will present the 1997 Mid-Atlantic States VHF Conference at the Horsham Days Inn, 245 Easton Rd. (Rt. 611 one half mi. above the Willow Grove Exit #27 of the PA Turnpike). For room reservations, call (215) 674-2500. Reg. is $12 per person at the door, which includes an admission ticket for "Hamarama," being held the following day. Contact *John Sortor KB3XG, 1214 N. Trooper Rd., Norristown PA 19403. Tel. (610) 878-5674;* or *E-mail [johnkb3xg@aol.com].*

OCT 5

WARRINGTON, PA The Mt. Airy VHF Radio Club (Pack Rats) will hold its annual "Hamarama" at the Bucks County Drive-In, Rt. 611 (4 mi. above the Willow Grove Exit #27 of the PA Turnpike), between County Line Rd. and Street Rd. Doors open to vendors at 6 a.m. for outdoor tailgating spaces; $8 each (plus general admission charge). Sellers of new and used amateur radio equipment, electronic components, and computer hardware/software vendors are invited to participate. Open to the public at 7 a.m. Donation $5. Talk-in on 146.52 simplex. For more info, contact *Brian Taylor at (215) 257-6303 between 7 and 9 p.m.*

WEST LIBERTY, IA The Southeast Iowa Hamfest will be held 7 a.m.–2 p.m. at the Muscatine County Fairgrounds. Adm. $5, children under 12 free. Free parking. Tables for commercial vendors inside main buildings. For reservations and info, call *Rob Boorman KBØMRZ at (319) 351-3399, or Bud Pitt WBØMEW, (319) 264-1788.* Outside flea market space free with gate ticket. Handicapped accessible. VE exams at 10 a.m., walk-ins accepted but pre-reg. preferred; please contact *Tom Kramer KØVSV, (319) 264-3259.* Overnight camping, electrical hookup $5. Pre-hamfest weiner roast on hamfest grounds, Sat., Oct. 4th at 6 p.m. Adults $3, children $2. See the *Web site at [http://soli.inav.net/~icarc/].* Talk-in on 146.850(-).

OCT 11

EVANS, GA The Augusta Hamfest will be held at Evans Middle School in Evans GA. Setup Fri., 6 p.m.–9 p.m.; Sat. 6 a.m.-9 a.m. VE exams start at noon. Contact *Frank KS4OC,* or *Rhonda KE4DIM* at *(706) 560-9600;* or write to *P.O. Box 3072, Augusta GA 30914.*

BREMERTON, WA Kitsap County Fairgrounds' President's Hall, at the NW corner of Fairgrounds Road, at Nels Nelson Road, is the site for a Special Event being sponsored by the North Kitsap ARC. Admission $4 for 12 and over, under 12 free. New and used equipment. Tables $15 ea. (incl. 1 free admission) until Sept. 30th; $20 ea. after that deadline. Commercial spaces $30. Contact *Susan Johnson AB7MD, P.O. Box 1226, Poulsbo WA 98370. Packet [AB7MD@N7WE.#WWA.USA.NOAM]; E-mail [sujohnso@linknet.kitsap.lib.wa.us].* Talk-in on 145.31(-) offset KC7FA rptr., or 146.52 simplex.

TAMPA, FL The Egypt Temple Amateur Radio Assn. will host a hamfest in the Unit Building at 4050 Dana Shores Dr. Admission $5, children under 10 admitted free. Tables w/2 chairs, $10 ea. plus admission. Electricity will be available, but customers must supply their own cable. Tables, tickets, can be obtained from *J.F. Strom K9BSL, 233-34th Ave. North, St. Petersburg FL 33704-2241. Tel. (813) 822-9107.* Talk-in on 146.94. No food and drink will be allowed except that sold by Egypt Temple members.

OCT 11 &12

MEMPHIS, TN "MemFest '97," the Greater Memphis Amateur Radio and Computer Show, will be held by Greater Memphis amateurs at Big One Expo Center, 2585 North Hollywood at I-240. Times: Sat., 8:30 a.m.–4 p.m.; Sun. 8:30 a.m.–2 p.m. Admission $5 at the door. Non-ham activities, ladies' activities and forums. VE exams Sat. and Sun. 9 a.m.–10 a.m. Flea market tables, 8', $25 ea. for the weekend. Contact Walt Heald *WB4GIJ, (901) 829-3712, FAX (901) 829-2214.* Exhibitors, contact *Mary Moore AC4GF, (901) 758-0661, FAX (901) 751-6717.* For general info, contact *John Lovett KD4EUH, (901) 388-8745, FAX (901) 937-8660.* Send correspondence to *1997 MemFest, P.O. Box 751841, Memphis TN 38175-1841.* Talk-in on 147.03/147.63.

OCT 12

DURHAM, CT The 1997 Nutmeg Hamfest and Computer Show will host the 5th annual ARRL Connecticut State Convention at the Fairgrounds in Durham, 9 a.m.–3 p.m. Campsite and vendor setup on Sat., beginning at 4 p.m. The featured speaker is John Hennessee N1KB, ARRL Regulatory Specialist. Flea market, commercial displays, VE exams, contact Joel Curneal N1JEO, (203) 235-6932 (register in advance); free parking, reserved overnight camping (limited elec./water), demos, seminars. General admission $5, children under 12 free. Vendors, contact *Gordon Barker K1BIY, 9 Edge Wood Rd., Portland CT 06480; (860) 342-3258. Packet inquiries, [W1KKF@W1NRG.CT.USA.NA]; E-Mail [sbicycle@connix.com].* The Nutmeg Hamfest is a cooperative venture of Meriden ARC, Middlesex ARS, and Shoreline ARC. Talk-in on 147.36/.96 MHz rptr.

MASON, MI The LCDRA and CMARC Hamfair will be held 8 a.m.–1 p.m. at the heated Community Center in the NW corner of the Ingham County Fairgrounds. Admission $4 per person. Tables $10 ea., trunk sales $5. Overnight camping available. Vendor setup at 6 a.m. Contact *Chuck McNease N8CM* or *Linda McNease KC8DPZ, at (517) 694-2757;* or *LCDRA, P.O. Box 80106, Lansing MI 48908.* Talk-in on 145.390.

OCT 17, 18 & 19

HOUSTON, TX The 3rd Annual Gulf Coast Ham Convention will open with commercial displays, 9 a.m.–5 p.m. Sat., and 9 a.m.–1 p.m. Sun. Setup will be Fri., Oct. 17th. To make booth reservations, please call *(800) 563-4598 and select option 2* when the voice mail answers. You may also call the Commercial Exhibitor Chairman, *Jim Lane N5DC, at (281) 358-0051.*

OCT 18

GRAY, TN The 15th Annual Tri-Cities Hamfest will be held at the Appalachian Fair Grounds, located off I-181 in Gray. A large drive-in indoor and outdoor flea market space is available. RV hookups. Admission $5. The hamfest will be sponsored by the Kingsport, Bristol, and Johnson City Radio Clubs. Mail inquiries to *Tri-Cities Hamfest, P.O. Box 3682 CRS, Johnson City TN 37602.*

OCT 18–19

EL PASO, TX The International Hamfiesta will hold their annual hamfest at the Texas National Guard Bldg., Sat., 8 a.m.–5 p.m., Sun. 8 a.m.–1 p.m. VE exams both days. Admission $5 advance, $6 at the door. Tables $10 in advance, $12 at the door. QCWA Breakfast. Seminars and tours. Talk-in on 146.88 rptr. RV parking, no hookups. Contact *Clay Emert K5TRW, P.O. Box 23010, El Paso TX 79923* or call *(915) 859-5502. E-mail: [cemert@dzn.com].*

OCT 19

CAMBRIDGE, MA The MIT Electronics Research Society, the MIT Radio Society, and the Harvard Wireless Club will hold a Tailgate Electronics, Computer and Amateur

Radio Flea Market 9 a.m.–2 p.m. at Albany and Main Sts. Admission $4. Free off-street parking. Tailgate room. Sellers $10 per space at the gate, $9 in advance (includes 1 admission), setup at 7 a.m. For space reservations or info, call *(617) 253-3776.* Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* This event will be held rain or shine. Covered tailgate area available for all sellers. Talk-in on 146.52 and 449.725/444.725 pi 2A—W1XM rptr.

SALEM, IL The Centralia Wireless Assn., Inc., will hold its annual hamfest at the Salem Community Activity Center, East Oglesby St., Salem IL. Setup is at 6 a.m. The hamfest will open at 8 a.m. Flea market tables are available on a reserved-in-advance basis; contact *Daisy King AA9EK, at (618) 532-6606.* Admission $2 each or 3/$5 and may be purchased in advance or at the hamfest. Mail ticket orders with an SASE to *Centralia Wireless Assn., Inc., Hamfest Tickets, P.O. Box 1166, Centralia IL 62801.* Talk-in on 147.27/.87.

KALAMAZOO, MI The 15th annual Kalamazoo Hamfest will be held starting at 8 a.m. at the Kal. Cty. Fairgrounds. Setup at 6 a.m. For info, call *(616) 657-4482;* or *E-mail [amcneil@net-link.net];* or SASE to *Al McNeil K8CRH, 816 East Michigan Ave., Ste. 102, Paw Paw MI 49079-1215.*

NEWTOWN, PA "Tradefest '97" will be sponsored by the Penn Wireless Assn., and held at Bucks County Community College, Swamp Road. VE exams. Free parking. Admission $5, under 12 free w/adult. Spaces, $10 outdoor, $15 indoor. Tables available on request—reserve early. Contact Steve at *(215) 752-1202.* E-mail to *[sewall@erols.com]* or send to *PWA Tradefest '97, P.O. Box L-734, Langhorne PA 19047.*

OCT 25

ST. PAUL, MN The Twin Cities FM Club will sponsor the 13th Hamfest Minnesota & Computer Expo at the St. Paul Civic Center, Kellogg and 7th Sts. There will be Fri. night VE exams. Flea market, educational seminars, more. Admission is $5.50 in advance, $7 at the door. Flea market setup is on Fri. night. The event will be open to the general public, 8 a.m.–4 p.m. For info and tickets, write to *Hamfest Minnesota & Computer Expo, P.O. Box 5598, Hopkins MN 55343;* or call the Hamfest Minnesota hotline at *(612) 535-0637.*

RICKREALL, OR The Mid-Valley ARES will present its 3rd Annual "Swap-Toberfest," ARES/RACES Convention, 9 a.m.–3:30 p.m. at the Polk County Fairgrounds. Self-contained RV spaces available. Handicapped hams who have pre-registered may enter at 8 a.m. through the East Door; one pre-registered assistant per handicapped ham may accompany to offer a helping hand. Features include swap tables, commercial dealers, meetings and seminars. Additionally, emergency communications vehicles will be on display from Marion and Polk County Emergency Management, Civil Air Patrol, American Red Cross, Intel, and others as available. For more info, contact *Garry Zinn KC7BSX, (503) 838-2008.* To download a copy of the flyer and pre-reg. form, surf the net for *[http://www.teleport.com/~n7ifj/swaptobe.htm].* Talk-in on the 146.86 rptr.

SUMTER, SC The Sumter ARA's 11th Annual Hamfest, Computer Fair, and ARRL State Convention will be held at Sumter County Exhibition Center, 700 W. Liberty St. Doors open 8 a.m.–4 p.m. Contact Steve Bregger *KD4HTS, P.O. Box 52302, Shaw AFB, SC 29152-0302; Tel. (803) 983-4251.* Or contact *Dee Brown NØZTV, P.O. Box 52141, Shaw AFB, SC 29152-0141; E-mail [deebrown@sumter.net]; Tel. (803) 499-6315.*

OCT 26

DES MOINES, IA "Hamfest Iowa '97" will be hosted at the Iowa State Fairgrounds' 4H Building, by Tikva Tracers ARC. Adm. $5. 1st table $10, add'l $8. Electric $8. VE exams at 9:30 a.m. Seminars and "Ask the Experts" will be featured. Contact *Randal Lees NØLMS, 1575 Northwest 78th St., Clive IA 50325-1255. Tel. (515) 279-4241; E-mail [rclees@raccoon.com].* Talk-in on 146.22/.82.

SELLERSVILLE, PA The RH Hill ARC will present their Hamfest at the newly rebuilt Sellersville Fire House, Rt. 152, 5 mi. S of Quakertown and 8 mi. N of Montgomeryville. Admission $5. VE exams 10 a.m.–1 p.m., all classes. Bring documents. Indoor spaces $12 (table included); outdoor $6, bring tables. Contact *Linda Erdman, 2220 Hill Rd., Perkiomenville PA 18074. Tel. (215) 679-5764.* Talk-in on 145.31.

NOV 1

WAUKESHA, WI The Milwaukee Repeater Club will sponsor the 13th annual "6.91 Friendly Fest" 8 a.m.–1 p.m. at the Waukesha County Expo Center Arena Forum, N1 W24848 Northview Rd. in Waukesha WI. Setup at 5:30 a.m. Tickets $5, 4' tables $5. Please call *Burt N9VBI, (414) 328-0535.* Send SASE with payment to *The Milwaukee Repeater Club, P.O. Box 2123, Milwaukee WI 53201. Web page [http://www.execpc.com/~mrc/friendlyfest.htm].* On-site VE exams. Talk-in on 146.91 (-) (The Friendly Repeater) and on 146.52.

NOV 8

MONTGOMERY, AL The Montgomery ARC will host the 1997 Alabama ARRL State Convention and the 20th annual Montgomery Hamfest and Computer Show in Garrett Coliseum at the South Alabama State Fairgrounds located on Federal Drive in the NE section of historic Montgomery. Adm. $5, free parking, all indoors including the flea market. Setup 3 p.m.–8 p.m. Fri., Nov. 7th; and 6 a.m.–7:30 a.m., Sat., Nov. 8th. Doors open to the public 8 a.m.–5 p.m. CST. VE exams on site beginning at 8 a.m. Bring original and a copy of your current license, picture ID and $3. Talk-in on 146.24/.84, call W4AP Ragchew 146.32/.92 (with phone patch, *up/#down), 147.78/.18, and 449.50/444.50. Flea market reservations are encouraged. Kickoff banquet Fri. evening at Bonnie Crest Country Club, with ARRL national staffer Rick Palm K1CE. Contact *Patty at (334) 567-7195,* or *E-mail to [prolan@juno.com]* for reservations. ARRL QSL card verification for all awards (WAS, DXCC, etc.) on site. For more info or table reservations, write to *Hamfest Committee, c/o 2141 Edinburgh Dr., Montgomery AL 36116-1313;* or phone *Phil at (334) 272-7980 after 5 p.m. FAX (334) 365-0558;* or E-mail *[WB4OZN@worldnet.att.net].*

SPECIAL EVENT STATIONS

OCT 5

PITTSBURGH, PA The Breeze-shooters ARC will operate station W3XX from the submarine *USS Requin*, docked at the Carnegie Science Center of Pittsburgh PA, 1400Z–2100Z. The station will operate vintage CW equipment in the 40-meter Novice band and in the Novice portions of the 10- and 15-meter bands, if conditions permit. Phone operation will be in the General class segment of 20m and 40m. For a certificate and QSL card, send QSL and an 8 1/2" x 11" SASE to *Jack Buzon KA3HPM, 47 Grubbs Rd., Cheswick PA 15024.*

OCT 18–19

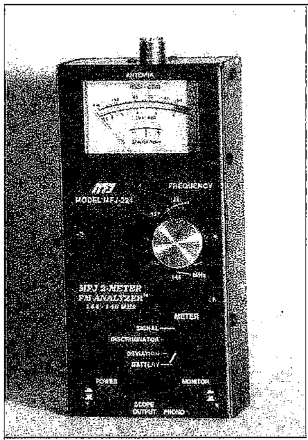
NUTLEY, NJ W2GLQ will be operated by the Nutley ARS from the Nutley Red Cross Building, to celebrate "Annie Oakley Day." Operation will be 1400Z Oct. 18th–2300Z Oct. 19th, on 3940, 7240, and 14240. For a certificate, please send QSL and a 9" x 12" SASE, to *N.A.R.S., c/o Nutley Red Cross Bldg., 165 Chestnut St., Nutley NJ 07110.*

OCT 31–NOV 1

BREVARD, NC The Transylvania County ARC (KE4ZIS) will sponsor their 9th annual "Halloween Fest" at the Devil's Courthouse, located on the famous Blue Ridge Parkway in Brevard. The station will be on the air 1800 GMT Oct. 31st–0200 GMT Nov. 1st. Frequencies: 7.237, 14.295, 21.305, 28.335, 146.25 MHz (+/-10 kHz for QRM). Certificate available with large SASE to *TCARC, P.O. Box 643, Brevard NC 28712.* 73

Number 48 on your Feedback card

New Products



2m Hand-held Tester

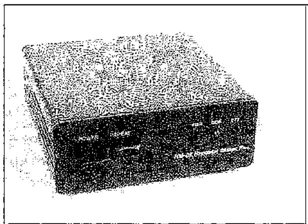
The MFJ-224 Two Meter FM SignalAnalyzer™ may be the most useful two meter hand-held test instrument you'll ever own. Measure signal strength over a 60 dB range; check and set FM deviation; measure antenna gain, beamwidth, front-to-back ratio, sidelobes; analyze audio quality with an oscilloscope, and much, much more!

Plug in any scope and the FM SignalAnalyzer becomes a service monitor. It lets you visually analyze modulation waveforms, and measure audio distortion, noise and instantaneous peak deviation.

You can tune in any signal between 143.5 and 148.5 MHz. A built-in discriminator meter function makes accurate tuning simple and easy. You can also evaluate antenna performance, compare antennas, check real-world performance of experimental antennas against computer predictions, document end-to-end cable loss in dB, plot field strength patterns for repeater or packet nodes, position your antennas to the best possible spot, measure preamp gain, track down hidden transmitters, check the speech quality of your radios ... and on and on.

The MFJ-224 uses a 9 V battery, measures 4 x 2-1/2 x 6-3/4 inches, and of course it comes with MFJ's "No Matter What" one-year unconditional warranty—and it's only $159.95!

For the name of your nearest dealer or to order, call (800) 647-1800; FAX (601) 323-6551; or write to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.



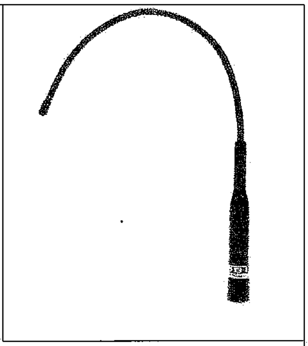
Repeater Maker *Plus*™

CES Wireless Technologies Corp. has developed a new, enhanced version of the popular Repeater Maker, called the Repeater Maker *Plus*, Model RM-20. This all-new device allows users to make a repeater out of two transceivers or separate transmitter and receiver modules.

The RM-20 provides a built-in four-user CTCSS tone panel, supporting any four of 50 CTCSS tones as well as cross-tone encoding. Among many standard features are Morse code CWID with programmable "send" states, and an "auxiliary relay" for remote control.

The RM-20 is programmed using a DTMF telephone locally, or remotely, over the air. This unit accepts the optional CES Voice Delay module for customization of application timing. The RM-20 features compact size, rugged housing, and is plug-and-play compatible with the CES 4700VP telephone interconnect. See your dealer.

Whip It



The new Comet SBB-1/SBB-1NMO is a 2m/70cm mobile antenna designed to solve the problems associated with mounting antennas on high-profile and sport utility vehicles. The whip is flexible and rubber-coated, similar to a rubber ducky HT antenna. It's rigid enough to stay vertical while driving but flexible enough to hit trees and other temporary obstacles without breaking.

The black anodized SBB-1/SBB-1NMO radiates a 1/4 wave on VHF, and a 1/2 wave on UHF. It's 16 inches tall and is available in the two most popular mounting styles—the SBB-1 has a PL-259 connector, and the SBB-1NMO has an NMO-type connector.

Both versions are now available from amateur radio dealers. For more information, contact NGC Company at (800) 962-2611 or visit the Comet Web site: [www.cometantenna.com].

"Bond. Conductive Bond."

Master Bond Inc. has introduced a two-part, silver-filled, electrically conductive adhesive that cures rapidly at room temperature. They call it EP77M-F, and it has an easy-to-use 1:1 mix ratio, by weight or volume. It'll set up at ambient temperatures within five to seven minutes, even when mixed in small amounts. EP77M-F develops a high bond strength of 1500 psi tensile shear when fully cured at room temperature, and electrical conductivity develops rapidly and is noted within 30 to 40 minutes.

Master Bond EP77M-F is 100% reactive and contains no diluents or solvents. It can be applied with very little sagging or dripping, even on vertical surfaces, and adheres to metals, glass, ceramics, vulcanized rubbers and many plastics. Bonds are resistant to chemicals (including oil), water, and most organic solvents. For more information, contact Master Bond Inc., 154 Hobart St., Hackensack NJ 07601. Call (201) 343-8983 or FAX (201) 343-2132.

Track It Down

The Futuretech Sourcebook, by Larry Ball, is an innovative directory of 147 mail-order vendors. The book's 394 useful, entertaining categories range from capacitors to lasers, fog machines, and personal radar guns. Tables make it easy to compare each company's product lines, and may eliminate the need to place orders with multiple vendors when building your next project.

Along with a description and listing of what each company sells, the book includes each vendor's name, address, phone numbers, Web site, and whether they take credit cards or require a minimum order. The 63-page *Futuretech Sourcebook* is available for $11.95 plus $3.00 s&h (Florida residents add 7% sales tax) from Futuretech, P.O. Box 6291, Gulf Breeze FL 32561. For more information or to order call (850) 932-9682.

NEVER SAY DIE
Continued from page 40

true circles just bent the hay, thus not really damaging it. No one has been able to figure out how to do this yet. Also, on true hay field patterns, there are no signs of the hay being disturbed by anyone walking into the field.

These patterns have been observed in hay fields all around the world, with over a thousand appearing in British fields in one year. Many are very intricate patterns. The question arises in more inquisitive minds: Why is who going to all this trouble? Surely there must be some reason for all this. The variety of patterns and their complexity certainly hint that some non-trivial intellect must be involved. Mother Nature may be capricious, but She doesn't have any known mechanism for instantly bending the hay in fields into weird fractal patterns.

One chap, piqued by these questions, started doing what the rest of us had failed to do: he started thinking. Doug Ruby has, as a result, written a book explaining what he has discovered. Fascinating book.

Early on, after making some cardboard models of the patterns, he decided that they must be two-dimensional representations of three-dimensional somethings. When he constructed cardboard models on this basis everything began to fit into place. What emerged, Doug is convinced, is the model for building a space ship, along with some strong hints on making a drive unit powered by element #97, Berkelium-247.

How much does our beloved government know about all this? When the figures "E97+" appeared in a Kansas wheat field one morning in 1991 government agents quickly moved in and eradicated them. This could lead some of our more alert people to start thinking, Hey, why would the government do *that*? Which of those 22 secret government agencies did it? What else have they been covering up? Why are they doing all this in secret? Well, perhaps it's better if we just go to back to watching TV soaps or seeing who's on the repeater and resume our sleep through life.

If you're interested in reading the well-illustrated book, *The Gift, The Crop Circles Deciphered* by Ruby, it's ISBN 1-878398-14-8, 174pp, 1995, Blue Note Books, 110 Polk #3, Cape Canaveral FL 32920 (800-624-0401). Copies are $33 postpaid in the US. No, I don't sell the book.

At the least the book will give you something else to talk about on the air other than your weather ... and give your friends more reason to suspect your sanity. It backs up what I find most credible, that the aliens (ETs, visitors) have been here for a long, long time and mean us no harm.

I found out about the book when Ruby was interviewed by Art Bell W6OBB one night on his "Coast-to-Coast" radio talk show. How a radio show at that unholy time of night has attracted the fourth largest radio talk show audience is weird. I set my VCR to record the five hours broadcast by a Philadelphia station on 1210 and listen to it in the kitchen when I'm fixing my meals or assembling the pages of my booklets on the counter. Well, it's at the right height and it's large enough.

You feed the output of a radio into the audio-in jack of the VCR and set it to record "line." This makes it easy to fast forward through the roughly 50% news and commercials interspersed in Art's show, taking more like two and a half hours to hear the whole five hours. It's on around 360 stations, so you should be able to hear it. The weakest area is the northeast corridor, from Philadelphia to Maine. The show runs from 1-6 a.m. EDT.

You'll hear stuff about the Pyramids, UFOs, contactees, and even me, every few weeks, talking with Art about ham radio, cold fusion, how anyone can be healthy, wealthy and wise, and so on.

So who's this guy Ruby? He started as an Air Force pilot and then flew for 24 years as a commercial airline pilot.

His conjecture certainly fits in with the scenario in the movie *Contact*, where they got the spaceship plans via radio signals from space.

Crash!

Have you done anything at all about getting your ARRL director on the stick to get our hobby growing, or are you just enjoying the usual exchange of less than nothing on the air as a way to get through this life without having made the slightest difference?

Yes, I'm being rotten. Well, unless your pressure on the League is visible in some way, like even the slightest mention in a club newsletter, or a copy to me of your efforts to prod your director to get the ARRL to do what it is supposed to do — support the hobby — then I'm not far off base in assuming that you've done nothing.

What am I grousing about? Well, I took another look at the latest FCC license numbers. Get out a pencil and draw a graph for yourself and see where things are going. Starting in 1985, 60.9% of us were General Class and above. By 1990 it was down to 55.7%. In 1993 is was 49.7%. And this year it went down to 43.7% by midyear. Now, if you'll continue the curve what you'll see is a remarkably straight line that'll hit 0% General and above by 2021.

The question that comes to mind is how long the ARRL is going to wait before taking action. Will it take another five or 10 years for the directors to figure out that their fanaticism over maintaining the code barrier may be misplaced?

Our low bands are already less crowded. In another 10 years we're going to have to hunt around for someone to talk with. There won't be many more DXpeditions, because most of the DXers will be trying to get the hang of their silent keys by then (if I can't take my mike with me, I'm not going), so what few pileups there are will mostly be the JA youngsters.

By 2021 I'll be 99 and hanging in there, keeping the curve from going below zero. Will I be the last ham on 20 m? Well, I was one of the first when they opened the band after the war. What a melee that was! Thousands of hams were on there a day or two before the official opening, using CB-type names for calls.

If you are still convinced that the FCC should maintain the code barrier to upgrading, then I hope you enjoy watching our hobby sink out of sight. Draw the graph
Continued on page 74

Number 50 on your Feedback card

Carr's corner

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041-0099
[carrjj@aol.com]

Finding antenna dimensions by scaling

Designing most standard antennas requires no great effort. For example, most hams know that the overall length of a half wavelength center-fed dipole is $468/F_{MHz}$ feet or $143/F_{MHz}$ meters. For example, if we want to design a dipole for, say, 14.250 MHz, we know that the length is 468/14.25 = 32.84 feet long. But this method falls down a bit when we try to design antennas that are more complex. For the sake of simplicity, however, let's look at the dipole problem first ... and, in the process, discover a simplified method for designing antennas.

Our simplified design problem is based on a simple procedure: *frequency scaling*. We find a design that meets our needs, but is at the wrong frequency, and then scale it. Scaling can be done by dividing the design frequency by the desired frequency, and then multiplying each of the lengths and spacings by this figure. For example if α is the scaling factor, we state that $\alpha = F_{DESIGN}/F_{DESIRED}$ and then multiply each length and spacing by α.

Consider our sample design of 14.25 MHz and 32.84 feet. Suppose we want to scale the antenna to 21.2 MHz? We can use the equations or we can scale it. For our example:

$$\alpha = F_{DESIGN}/F_{DESIRED}$$

$$\partial = 14.25\text{ MHz}/21.2\text{ MHz} = 0.6722.$$

To find the length of the desired antenna we need only multiply the length of the known antenna by α:

$$L_{NEW} = L_{KNOWN} \times \alpha$$

$$L_{NEW} = (32.84\text{ feet})(0.6722)$$

$$L_{NEW} = 22.08\text{ feet}$$

In the trivial case of the dipole we can easily check the result:

$$L = 468/21.2 = 22.08\text{ feet}$$

Rule: When using the scaling method, scale all dimensions and spacings of the antenna. In scaling a beam, for example, it does no good to scale the element lengths but not the spacings. *All* lengths and *all* spacings must be put through the scaling process.

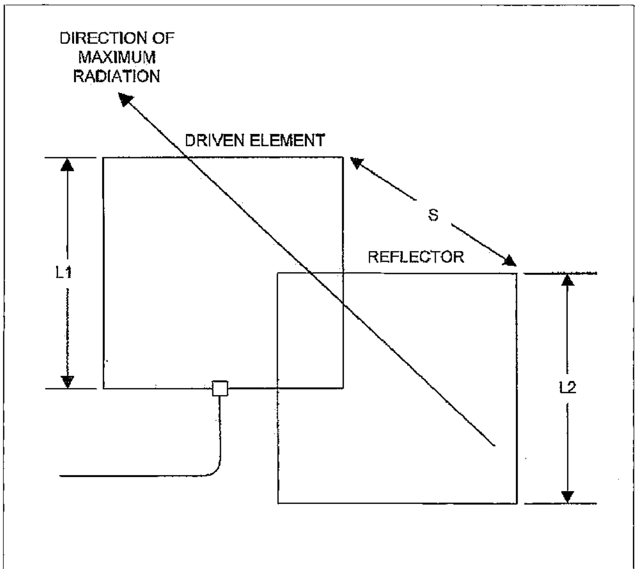


Fig. 1. Two-element cubical quad.

The usefulness of scaling becomes apparent when you want to design complex antennas such as quad or yagi beam antennas. You often find successful designs in magazines and handbooks, but they are not on the frequency that you wish to use—or they might be on a completely different band. The answer is to use scaling. Let's consider an example. Bill Orr's (W6SAI) *Radio Handbook 18th Edition* (an oldie!) gives the dimensions for a two-element cubical quad antenna (**Fig. 1**) as follows.

For 21.250 MHz:

L1 = 11.8 feet
L2 = 12.1 feet
S = 5.56 feet

In the case of the cubical quad beam all four sides of each element are equal, so the circumference is four times L1 or L2. Now let's suppose we get our wildest wishes and are able to put up a 75-meter band cubical quad. The dimensions for 3.750 MHz can be found from scaling. The factor $\alpha = F_{DESIGN}/F_{DESIRED} = 21.250\text{ MHz}/3.750\text{ MHz} = 5.667$.

L1 = 11.8 feet x 5.667 = 66.87 feet
L2 = 12.1 feet x 5.667 = 68.57 feet
S = 5.56 feet x 5.667 = 31.51 feet.

The yagi beam antenna is very popular, and on some bands is relatively easy to build (on lower bands it might be easier to buy one, given the nature of the metalwork needed to make a safe and reliable antenna).

The basic three-element yagi antenna is shown in **Fig. 2**. Although three elements are shown here, it is also possible to build a two-element yagi or a yagi with more (even many more) elements than three. The reason for looking at the three-element version is that it provides a look at all three classes of elements: *driver* (or *"driven element"*), *reflector* and *director*. The driven element is a half-wavelength dipole, and is the only one that is connected to the transmission line from the receiver or transmitter. Because only one element is fed, the other elements are called *parasitic elements*, and the antenna is sometimes called a *parasitic beam* to distinguish it from *phased array beams* in which all elements are driven.

The gain achievable by the yagi depends on several factors, but in general, the following values are realized relatively easily:

No. of Elements	dBd	dBi
2	5.2	7.4
3	6.8	8.9
6	10.5	12.6

Table 1. Gain achievable by the yagi.

The driven element is little more than a half-wavelength dipole, fed in the center by coaxial cable. The

ELEMENT	ELEMENT LENGTH (λ)	POSITION (λ)
Reflector	0.49531λ	0λ
Driven Element	0.48598λ	0.13754λ
Director	0.46257λ	0.27508λ
$\lambda = 984/F_{MHz}$ feet or $\lambda = 300/F_{MHz}$ meters (Boom position uses reflector as reference, so sets position at zero)		
SPACING (S = ΔX) S1 0.13754λ S2 0.13754λ		

Table 2. Three-element beam spacing factors.

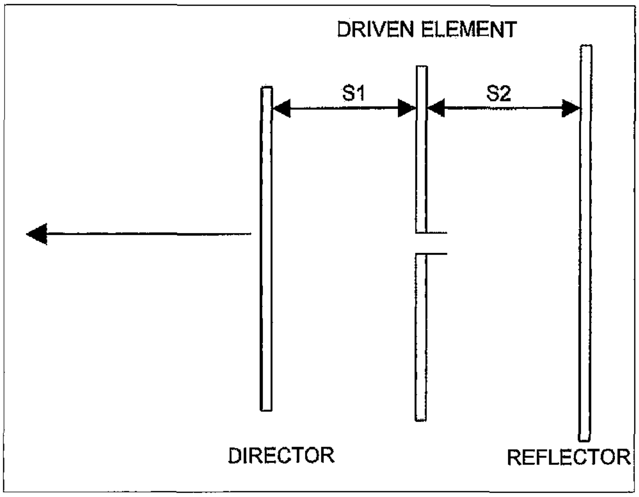


Fig. 2. Three-element yagi.

transmission line divides the driven element into two quarter-wavelength halves. The reflector and director are also half-wavelength, but being parasitic elements are not fed in the center or any other point. The parasitic elements are spaced (S) from the driven element about 0.131λ to 0.271λ (specific spacing is in **Table 2**).

The driven element is about half a wavelength long. The reflector is a few percent longer than the driven element, while the director is a few percent shorter. In some multi-element designs, additional reflectors or directors may be added to increase gain. As with all such yagi antennas, the directivity is towards the direction of the smallest element. In the example of **Fig. 2**, the directivity is from the driven element towards the director. In that direction, received signals are louder, and transmitter signals appear stronger to distant receivers.

Increasing the number of elements will increase the gain and narrow the beamwidth of the yagi antenna. Although there is a limit to the optimum number of antenna elements that can be fitted on a given size boom, the general rule is "the more the merrier." **Fig. 3** shows the layout for a very large beam of 19 elements laid out on a boom of about 5.6 wavelengths (λ). It is derived from one published in *The ARRL Antenna Book*. The gain is on the order of 15 dBd. It has an azimuthal beamwidth of 26 degrees, and an elevation beamwidth of 28 degrees. The feedpoint impedance is about 30 ohms.

This beam is designed using the scaling method. All elements and element positions (which also set the spacings) are related to a

Element	Length Factor (L)	Position Factor (P)
Reflector	1.087A	0P
Driven Element	1A	0.327A
Director D1	0.9989A	0.468A
Director D2	0.976A	0.732A
Director D3	0.959A	1.095A
Director D4	0.949A	1.552A
Director D5	0.939A	2.08A
Director D6	0.933A	2.673A
Director D7	0.929A	3.317A
Director D8	0.925A	4.01A
Director D9	0.920A	4.74A
Director D10	0.916A	5.507A
Director D11	0.911A	6.298A
Director D12	0.906A	7.106A
Director D13	0.902A	7.923A
Director D14	0.897A	8.746A
Director D15	0.893A	9.575A
Director D16	0.889A	10.41A
Director D17	0.885A	11.25A
Boom Length	11.25A	

Table 3. The normalized lengths of the elements and their positions relative to the reflector element.

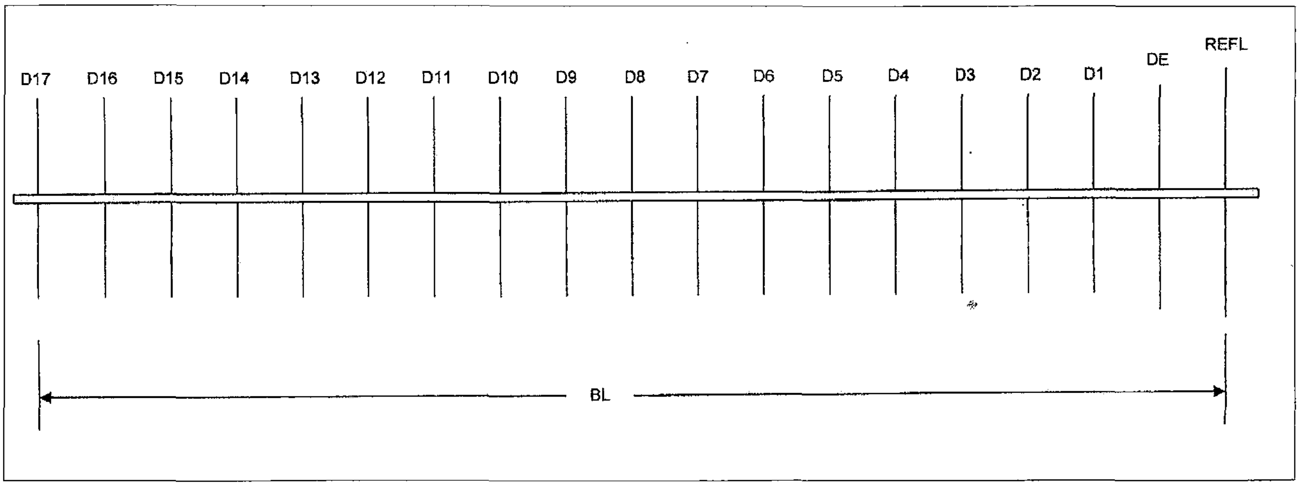


Fig. 3. Nineteen-element beam.

Number 52 on your Feedback card

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119
[clhough@pacbell.net]

QRP microwave rigs

QRP on the microwave bands? You bet!

Most of the communications that is carried on in microwave operation is with QRP rigs constructed from surplus materials. QRP operation is not limited to just the HF bands and small CW transceivers. QRP operation is the normal mode of operation, for the most part, as high power is very expensive and can be hard to locate.

Most of the component parts used to construct converters for frequencies above 1000 Hz have come from surplus material obtained at swap meets, flea markets and commercial surplus dealers. While there are kits available for those who want a package deal, most converters are of the QRP level. Costs can increase sharply for accessories for these QRP kits—higher power means higher price.

Don't scoff at QRP operation on the microwave bands; quite impressive contacts can be made with relatively low power rigs. Take for example the 10 GHz (10,000 MHz) wideband FM operation where power levels in the 10 milliwatt range are common and 100 milliwatts (0.1 watt) are the high power rigs. These rigs have made some very impressive contacts over great distances. The most notable was a shot across the Mediterranean, of some 1800 kilometers distance. That was an exception to the general rule, but it was done.

Now we all don't have that great path available, but impressive (and satisfying) contacts can be made. I remember my first 10 GHz contact, which happened within the confines of my garage. Later, distance increased to a city block, and within a week we were up to 20-mile contacts between hilltops. Power used was 10 milliwatts transmit power and a 30-inch dish with about 30 dB antenna gain.

Yes, we have lots of hilltops here in California, where an easy contact can be over 150 miles. The mountainous terrain of the west coast poses some interesting locations to shoot between and some very difficult locations to try to shoot over. However, some notable contacts have been made from Baja California to just above Santa Barbara, California, for distances of just under 600 kilometers. These shots take advantage of water vapor ducts formed near sea level on this entirely-over-the-ocean shot.

This sea level shot was like shooting fish in a barrel, as the water vapor forms a very low loss waveguide-like duct into which you transmit. Of course it's not there all the time but it can be used to great advantage when the condition is present. During the same times, a path that goes over land mass has much more path attenuation. In some conditions, while an over-the-water path is excellent, an over-the-land path can be so lossy that no contact can be made.

Again, if QRP rigs were used there would be no trouble with this power level for operation. We were using 10-watt microwave rigs and there was so much excess signal due to the duct conditions that lower power settings (if they had been available) would have sufficed.

This, then, is the territory we venture into, trying to make the best guesstimate on path loss conditions. Being microwavers, we seem to take more time in tuning up our rigs and building new devices to use than we do operating. We seem to have the scale tilted towards the soldering-iron side of amateur radio. This is because we all have to home-brew our own equipment.

There are kits and bits and pieces available from several companies, and quite a few are listed on the Internet with Web sites. These sites give you a preview of catalogs in descriptions, some with photos of the actual kits. There are many different sources for materials, and at various levels of experience, from beginner to the very serious top-of-the-line high-power UHF operator.

Of course the top-of-the-line stuff and its high price tag are the same in this hobby as in any other realm. If you're buying a Ford or Chevy, compare those numbers to a Lamborghini or Ferrari—the price scale is relative. Be prepared to invest in your equipment if you want to get very serious with high power and associated station adjuncts. They'll cost you a bundle.

Here's a short list of suppliers of microwave materiel for all levels of interest. These suppliers all are listed on the Internet and have Web sites that you can visit to get up-to-the-minute details about availability.

A great supplier to the amateur community is Down East Microwave, located in Frenchtown, New Jersey. This is a site that you have to explore. They have so much material available they have to list it (as in their catalog) on a band-by-band product description. As an additional bonus, their entire catalog is available on the Internet in a zipped file you can download. Their Web site can be contacted at [http://www/geociti.Vista/7012/ghz.htm]. You can also contact them by mail or phone at Down East Microwave, 954 Rt. 519, Frenchtown NJ 08825; (908) 996-3584 voice, and (908) 996-3702 FAX. Do look over this equipment list—it's very impressive.

Another company is SHF Microwave Parts Company in La Porte, Indiana. This site specializes in

---

scaling factor ("A") that is related to the size of the driven element. The value of "A" is:

A = 138,189/F millimeters (mm).

Where:

A is the scaling factor
F is the frequency in megahertz (MHz).

Table 3 shows the normalized lengths of the elements and their positions relative to the reflector element. The reflector is a position zero (0), and all others are at the position factor (P) locations.

These two beam antennas use slightly different approaches to the same concept: frequency scaling. They are, nonetheless, equivalent. Keep in mind, however, that there is a downside to frequency scaling. You are stuck with whatever assumptions were made by the original designer. For example, in the beams above the spacing can be varied to optimize performance, but not if you accept the frequency scaling method. Also, these designs assume cylindrical, not tapered, elements that have a very high length/diameter ratio.

I recently reviewed some ham software that helps you design antennas. Some of that software might be reviewed in these pages in the future. It became apparent looking at one program that frequency scaling was being used. The giveaway was a data file containing what I calculated were scaling factors using the Lawson method (see "Suggested reading").

If you want to delve deeper into the topic of antennas, let me recommend the books below (not to be immodest, but some of which are my own).

Suggested reading

ARRL, *The ARRL Antenna Handbook 17th Edition*. Newington CT: 1997 (check for later edition).

Carr, Joseph J., *Practical Antenna Handbook - 3rd Edition*, 1997, New York: McGraw-Hill.

Carr, Joseph J., *Antenna Toolkit*, 1997, Butterworth-Heinemann (Newnes), Oxford, UK.

Carr, Joseph J., *Joe Carr's Receiving Antenna Handbook*, 1994, HighText/Universal Radio.

Lawson, Dr. James L.(1986). *Yagi Antenna Design*. ARRL, Newington CT.

Orr, William I, and Stuart D. Cowan (1983). *Beam Antenna Handbook*, Radio Publications, Wilton CT, or any other antenna book by Bill Orr W6SAI.

Gunn diode material for the 10 and 24 GHz bands. He also has various PC board adjuncts to support the Gunn diode units for operation on wideband FM (WBFM), and video operation. His Web site is [http://www.shfmicro.com/]. If you can't get on the Web contact SHF by mail or FAX at 7102 W. 500 S., La Porte IN 46350. FAX (219) 785-4552.

A supplier of high-end 1296 MHz equipment is KB2AH. His Web site is [http://www.SignalONE.com/kb2ah/]. This URL lists some impressive photos of dish antenna structures and high-end amplifiers for both receiving and transmitting. There are water-cooling adapters that are used on commercial versions of the old reliable 2C39 microwave tubes for 1296 MHz.

Don't forget Hamtronics, 65D Moul Rd., Hilton NY 14468-9535; (716) 392-9430. While Hamtronics doesn't have microwave items, it does an excellent job of supplying kits for converting your 10m HF equipment to VHF for use with a microwave converter, saving you the cost of a 2m multimode rig. I have tried their 10 to 2m receiving and transmitting converters; they're good—and priced right.

Whatever route you embark on, study your path carefully, and shop wisely. Look for key items in your search, for equipment some of us refer to as "unobtainium." This term (unobtainium) is how I refer to mixers, relay switches, and basic amplifier components for the microwave region—component parts that commercially cost an arm and a leg, but for amateur operations, parts you don't have to mortgage the farm to buy. Put your efforts into the construction of a simple QRP microwave rig for your band of interest.

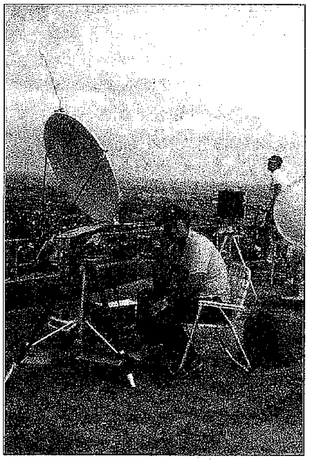


Photo A. WB6IGP on top of Mt. Soledad, San Diego, with my 10 GHz 50 mW wideband FM transceiver.

Where can you locate component parts from surplus?

Well, I would try surplus sales at flea markets and swap meets first. Then explore your local commercial markets to see what's available. Talk to TV and satellite TV technicians about the junk old units they have taken in trade or just removed from service. Try your local cable TV head end operations plant for your local CATV company. See if they will part with some materiel—and explain to them that this is to be torn down for parts for amateur operations, not put back into CATV use.

1296 MHz

Well then, what approaches did I take to construct a rig for each of our bands above 1000 MHz to 10 GHz? Let's start off with the 1296 MHz rig description. Having Qualcomm surplus material to experiment from made this job easy, in that I used the component cases for each rig, along with power supply and synthesizer components for each system. The 1296 MHz rig uses a receiver amplifier PC board for the main RX amp and a TX IF board for transmit. This basic unit was described in the January column. Essentially it is a synthesizer whose output is at 1152 MHz and is controlled by a very stable 10 MHz tcxo reference oscillator. The LO injects directly to the mixer at the +10 dBm drive level and couples the A filter and the switchable RX/TX preamplifiers. Currently transmit power is +10 dBm output. This stage will drive a one-watt amplifier from Fujitsu. This part of the project is under development.

2304 MHz

Material for this band was obtained from an old microwave Gunn diode system used for digital communications over short ranges. Being in the right place at the right time, I took the junk and boxed the entire system. Taking the entire system was a major factor here. If I had cherry-picked the parts I wanted, it would have not been made available; but by agreeing to take the scrap with the parts I *wanted* I got the deal. I removed filters, an RX preamp, and TX 100 mW amplifier, and tossed the remaining 150 pounds of junk. I fitted a Qualcomm synthesizer to output 2160 MHz (144 MHz IF frequency) for 2304 MHz operation.

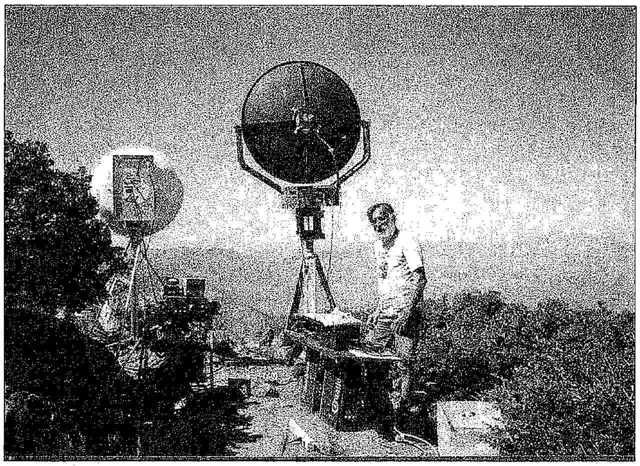


Photo B. Top of Mt. Laguna, eastern San Diego County, 5500 feet. White dish 100 mW SSB system from Ed W6OYJ. Left: Jerry pictured with his SSB system. Lots of contacts from this lofty peak, even one Arizona station, that all came through during the 10 GHz contest.

Directional couplers, RX preamp filters, and TX amplifier with relay manual switching finished the package. Not a powerhouse, as I could have added a power amplifier from military surplus that will put out four watts. I found operation at the 100 mW level to be very good, especially coupled with my 30-inch dish antenna. Besides, at QRP levels, the battery-operation current draw being reduced with low power means longtime use on the 12-volt battery source.

3456 MHz

The rig for 3456 MHz took some great thought before it could be constructed. I was thinking of using a crystal-controlled Frequency West brick-type

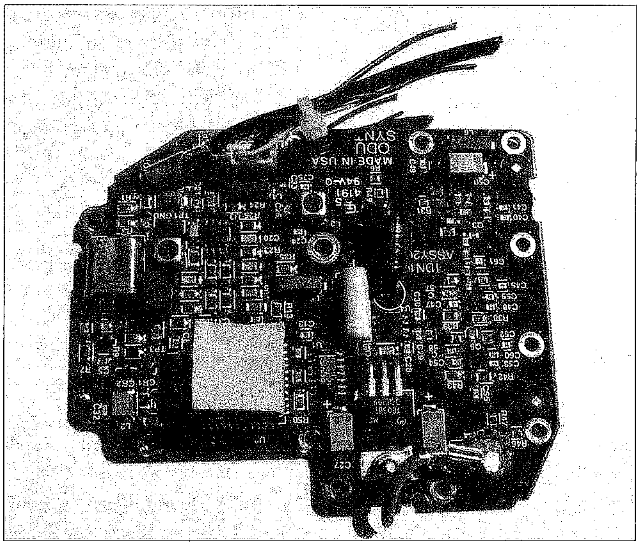


Photo C. An early version of the Qualcomm 3036 synthesizer that made our microwave rigs' construction possible.

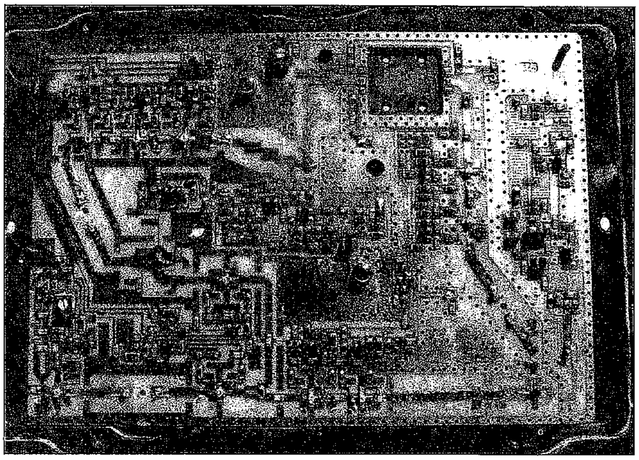


Photo D. The tiny Qualcomm transceiver for 10 GHz, originally part of a 12 GHz receiver and 14 GHz transmitter. Board contains all GaAsFET circuitry, 30 dB gain RX preamp, 30 mW TX, RX/TX IF amps, LO multiplier (x 4) from 2556 MHz driven from external synth board, LO distribution GaAsFET amplifiers and both RX and TX 10 GHz mixers. Physical size is six and a half by four and a half inches.

oscillator, but the units I had were all defective in one way or another. Where to find a local oscillator for 3456 MHz with a 144 MHz multimode as an IF system as used in all rigs? Where to come up with a 3312 MHz injection local oscillator?

I tried a synthesizer from a CATV head end receiver that proved to be stable for video, but not at all suitable for SSB—it had large phase noise products. The solution came when I married a low frequency Qualcomm synthesizer—similar to the one used in the 1296 MHz rig—and the multiplier unit from a Frequency West brick. The synthesizer was set to lock up at 828 MHz and the multiplier (times four) put the required 3312 MHz out. The rest was a small GaAsFET amplifier for receive and two-stage amplifier for transmit. Filtering was done with a simple waveguide below cutoff mode filter, one adjustable capacitor and two coax connectors, and a three-inch section of waveguide. Power output was low in the +10 dBm range—still a QRP rig to be sure.

5760 MHz

The rig for 5760 MHz was an easy unit to construct, because I had a 6 GHz Frequency West brick-type oscillator running at 5616 MHz with the same 144 MHz IF. Coupling that to a mixer and preamps for RX and TX gave me a nice system. I had a power amplifier that had one watt output and was quite small. Relay switching to transfer RX to transmit was accomplished by an RF detection circuit and switching delay sequencer. The relay sequence would turn off the receive contacts before making the transmit switch. This prevented turning on the transmit before the receive preamplifier was out of the circuit.

Frequency West brick oscillator, junk box double-balanced mixer, interdigital tuned surplus filter, relay switching automatic on RF detection; and two amplifiers complete this rig. Well, add the power supplies to drive 24-volt surplus relays, and supply +12 volts and -20 volts regulated for the brick oscillator. Sort of a jungle of power supply voltages to accommodate the different parts that required different supply voltages. Finding all items in the same voltage polarity is not a problem, as power supplies are relatively easy to construct—so make do with what you find surplus.

10.368 GHz

Well, the rig is totally Qualcomm from start to finish and synthesizer-driven. Stability in the few hundred hertz region. Receiver noise figure in the 1 to 2 dB NF range, gain 30 dB. The transmitter is one watt output with external amplifier or run barefoot at 30 mW power output. At this 30 mW power level, I have made many contacts and signals are strong. There is quite an improvement when the one-watt amp is switched in or its big brother the 10-watter.

The synthesizer is run at 2556 MHz and multiplied times four for a final local oscillator injection of 10,224 MHz. Again, the 144 MHz IF. I used the same RF detect transfer circuit and coax relay switching circuit that I used in the 5760 MHz rig.

All in all, these rigs show that parts and pieces from different manufacturers and military and commercial surplus can be combined to construct a microwave QRP rig. The answer is the same, no matter what frequency you want to construct for. Local oscillator, mixer filter and amplifier. Then come power supply considerations and switching circuits. On the simplest, a toggle switch was used to switch relays from receive to transmit manually before activating the 144 MHz transceiver to transmit.

In all cases, the power from the 144 MHz driving source was held to less than +15 dBm to prevent mixer burnout from RF power. You don't need lots of driving power to be applied to a transmitting mixer. Hope you have lots of fun locating those choice parts or putting together the kits that are available to construct for QRP microwave rigs. Best 73 for now. For questions please send an SASE or contact me on the Internet at [clhough@pacbell.net].

Number 54 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153
[ajr@ari.net]

A few months ago, I mentioned the old RTTY pictures we all used to send on the air. Constructed of individual letters, patterns of letters, and overstrikes, these works varied from simple line drawings to shaded masterpieces.

Well, I received a message from John Sheetz K2AGI, in New Jersey, who passes along the following:

"Don Royer WA6PIR and I were the ones who used to run the RTTY Picture Contest for several years. I have over 1400 RTTY picture tapes but have not run any of them for several years. I do have a complete Teletype model 28 setup and an ST-6 demodulator. At the moment, I am active only on two meters. The request in your column is the second one I have seen in the past year. I might consider reactivating my picture tape sourcing. I always had the idea of getting it all transferred to floppy disk or comparable but have never done it. The biggest problem of which I am aware is the inability for most printers to do overprinting. Of course, you cannot do it on the CRT screen in any way! My tapes were all originally 5-level Baudot, but I was in the process of converting them to 8-level ASCII when the whole world went to computers. With the demise of the *RTTY Journal*, I am afraid that the hobby is going to die completely. Maybe by the time it all becomes a nostalgia item, like tube-type hi-fi, we might have some renewed interest in the good old RTTY mode. I do have the means to reproduce the paper tapes if all of the equipment still works—haven't tried it in years! I also have a good supply of raw tape on hand, so that is not a problem. I wonder if there [would] still [be] any interest in [my] distributing the old pix tapes or [the] contests."

To illustrate to the uninitiated just what John is talking about, **Figs. 1** and **2** show some of the work he and Don circulated in the halcyon years of radio teletype. Although these are necessarily reduced, I think you can appreciate some of the work that went into their production.

Continued

Well, folks, what do you all say? Is there still any interest in paper tape, rolls of paper, and greasy printers? Or has just about everyone gone computer? I look forward to your comments on this one!

As long as we're dwelling on older technology, let's entertain another question.

Ted Bear W6RHB, passes along the following:

"I read your column in *73* all the time and really enjoy your many good ideas and references to RTTY. But now I have one question that's a bit away from RTTY ... namely, CW. Maybe you could help me ... ?

"I just finished building a nice QRP rig ... Simple, but works!! But it is CW *only!* Now, what I am looking for to bring it up to date is a *nice CW receive and transmit program* for my little RatShack laptop that I rebuilt. The thing is pretty old and unsophisticated, using only a 750K disk. No hard drive, etc., and uses a V20 CPU ... so-o-o slow-w-w ... But does use MS DOS 3.0 or some such archaic DOS ... Anyway, the program has to be pretty small ... and simple!

"I found a couple of nice programs that transmit but do not have a receive function. Hamcom[m] 3.1 is only one that I found that has both. But it requires an SSB rig and won't use a plain ol' CW rig; so the question is, maybe you might know the name of a program ... or maybe even *have* such a program??? It sure would be nice, as I would like to take the rig out for Field Day in some boondocks area and play."

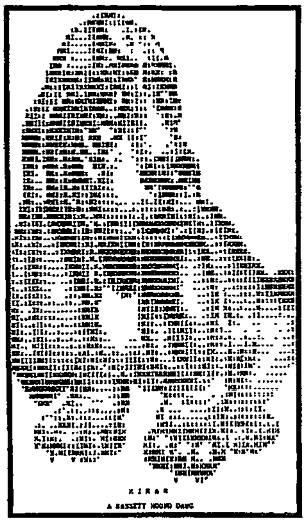


Fig. 1. "Hiram, a Bassett Hound Dawg." Originated by Don Royer WA6PIR, art by XYL Maxine.

Ted, this is one I cannot help you with. The old V20 chip, like its cousin the Z80, is poorly supported at this time. I imagine that an old BASIC language program might be of value to you, if one still exists for that computer. Otherwise, we'll see what comes of this posting in the column. Let me know how you are doing with this endeavor.

I enjoy all of the comments and questions you all have been asking about the multiple programs available to help run RTTY and other digital modes on computers. The latest addition to the RTTY Loop Software Collection, Disk #17, contains the following programs described in recent months:

FTV-DEMO.ZIP: WEFAX, FAX, SSTV, RTTY, and CW reception; FAX and color SSTV transmission with Soundblaster™ and compatible cards.

RAFT201.EXE: RadioRaft, a multimode radio data decoder. Supports the Hamcomm interface or an external modem. 9 ARQ modes, 10 FEC, CW, packet, RTTY... Automatic decoding of any mode at any speed. Frequency meter and baud meter included. Modes are: Baudot, ASCII, SITOR-A/B, ARQ-E, ARQ-M2/4, packet, ARQ-E3, RUM-FEC, FEC-A, SI-ARQ, SWED-ARQ, ARQ-6/90 and 98, CIS11, SPREAD11/21/51, CW, AUTOSPEC, SI-FEC, ARQ-N, IING-FEC.

RITTY206.ZIP: RTTY and Pactor using a Soundblaster card.

SBPMORSE.ZIP: Morse program using a Soundblaster card.

SSTVBL.ZIP: Slow-scan TV using a Soundblaster card.

How can you get copies of these programs? Just by sending US $2, a blank 3.5-inch disk for your PC, and a self-addressed stamped mailer to the P.O. Box address at left. Since this is Disk #17, those of you who just came in can assume correctly that there are sixteen other disks in the collection. A list can be yours for a self-addressed, stamped envelope, sent to that same address. Or, those of you who are cyber-connected can visit the RTTY Loop Home Page at [http://www2.ari.net/ajr/RTTY/] and view the entire list. You can also find some, although not all, programs to download. Unfortunately, server space considerations prevent me from keeping more than a few programs online at any one time. If there are particulars that you would like to see, though, drop me an E-mail at the address at top and I'll see what I can do.

Fig. 2. "Peace Through Victory." Also by the Royers.

My desire is to hear from you. By mail, by E-mail, or however you get them to me, I look forward to your comments.

Number 56 on your Feedback card

On the Go

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

HF mobile

While the vast majority of portable or mobile operations are in the two-meter or 440-MHz bands, one of the most fun types is working the HF bands. Imagine ragchewing without worrying about hitting the edge of the repeater coverage, or even when in an area not covered by a repeater. Imagine talking with Moscow or Alaska from the lower 48 while making an otherwise boring drive across miles and miles of miles and miles.

Perhaps the biggest reason that there is not more interest in HF mobile operations is because many people believe it is too difficult or too expensive. While there is some additional equipment required, it may not be as difficult as you may believe.

For HF, as for any other amateur radio station, you'll need a radio, an antenna, and a source of power. The source of power is relatively easy, of course, since most rigs require approximately 12 volts (actually 13.8 volts), the same as the car's electrical system. For any rig running over 10 watts, it is virtually imperative to run a cable of adequate size directly to the car battery, and to keep this power cable as short as possible. Keep the power cable away from the high voltage circuits to prevent interference from ignition noise.

Good practice dictates that the rig be turned off before switching on the car to avoid problems caused by spikes produced while starting the engine. However, many people add a relay that is used to shut off power to the rig when the ignition is switched off. In any case, don't forget to include an adequate fuse in the positive line.

The cables that come with many rigs are appropriate for mobile use—they're of the proper size and include an appropriate fuse. Most transceiver owners' manuals include recommendations for mobile operation, so check your manual for additional requirements.

The types of antennas suitable for mobile use are somewhat limited. Almost everyone uses a vertical antenna, although there are many variations on this theme. The biggest choice is between a multiband system or a monoband system. Multiband systems may either have resonators for each of the bands you plan on using, or they may be adjustable by having a plug which is moved to a different socket for each band.

Some people purchase several single-band antennas, one for each band to be worked. If each has a standard threaded base, it is easy to unscrew one mast and screw in another. Keep a wrench of the proper size in the car. By using the wrench to tighten or loosen the antenna, you minimize the chance that someone will be able to remove the antenna from your parked car and walk off with it. Make certain that the antenna and the coax are of the correct impedance for the radio you will use, or else you'll need an antenna tuner.

Unlike UHF and VHF antennas, a magnetic mount is not the optimum solution. In most cases a ball mount, which is permanently attached to the car fender, or a bumper mount is preferred. The ball mount will leave a hole in the side of the car which may be a concern when it comes time to sell it, but there are plastic plugs specifically designed to cover the hole when the mount is removed.

Bumper mounts were once very popular, but with so many plastic bumpers these days, it is necessary to ensure that the bumper will support the weight of the antenna; don't forget that the antenna will place more stress on the mount when the car is moving because of the wind load on the antenna. If you have a trailer hitch, you can mount the antenna next to the trailer hitch, but slightly offset.

It is a good idea, in any case, to mount the antenna at the rear of the car and keep it as far from the engine as possible to minimize interference by electrical noise. It is also important to keep the antenna away from other antennas you may have on the car. I prefer the left rear fender, because this helps avoid low-hanging tree branches. A spring at the base will help the antenna deal with unexpected obstructions. Finally, make certain that the mount is making good electrical contact with the car body, since the body provides the counterpoise for the antenna system.

The most fun decision, of course, is picking an appropriate rig. Most people will opt for single sideband, although some people do like FM on six or 10 meters. There are some folks who successfully operate CW while mobile, but for me that takes too much concentration away from driving.

There are a number of rigs that appear to be specifically designed for mobile or portable operation. Those with full features and 100 watts of output, such as the Kenwood TS-50S, are priced close to any full-sized, full-featured transceiver. Other units such as the 50 W Ten-Tec Scout Model 555 are priced a bit lower. Finally, the MFJ 20-meter SSB Travel Radio is a single-band, single-mode radio which is priced even lower.

On the other hand, it is very easy to use any number of other rigs for HF mobile operations. In the past I have used a Ten-Tec 580 Delta and a Kenwood TS-120 very successfully. If you run across a reasonably priced used HF rig, you may want to think about it for mobile operations. The biggest issue is to make sure that it will fit in your vehicle.

Unlike a two-meter rig, most HF rigs won't mount easily under the dashboard in most cars, especially with the way cars are designed these days. In the past, I've used a hump mount for the HF rig and mounted my dualband two-meter, 440-MHz rig right on top of it. I've also seen people mount their rigs on a plywood base which sits on the floor in front of the passenger's seat, oriented so it faces the driver. This is fine if you're traveling without a passenger, and can be easily moved when someone is sitting in the passenger's seat. Of course, unless your passengers are other hams, they tend to expect you to talk with them rather than on the radio anyway. In any case, you want to have the radio placed where you can see it easily, without it being a distraction from your driving.

Two words of warning are required. First, as my instructor used to remind me when I was learning to fly, the first thing to do is to fly the plane. When driving and operating mobile, the first thing is to drive safely.

Second, in today's automobiles many of the engine operations are controlled by a computer. That computer may be susceptible to RF interference. Check with your car manufacturer to determine if they have any recommendations concerning operating radios from your vehicle.

Next month I'll discuss some of the operating habits which are different in a mobile operation as compared to a fixed location. In the meantime, if you have any ideas or experiences with mobile operation, please let me know. 73

Calling All Hams!

Tell us about yourself! We at *73* are insatiably curious (OK, nosey) about our readers. So c'mon, spill it! Write to us—let us know who you are, what you do, how long you've been hamming, what got you involved, anything else you can think of—and include a sharp picture or two! Why bother? It *could* get you a check for a paid article in *73*, your photo in the magazine—maybe even a shot at the cover! Type it up, put it on a floppy (Mac format is always best) if you have a computer—don't forget to send a hard copy along with the diskette—and send the whole works to: **73 Editorial Department, 70 Route 202 N, Peterborough NH 03458.**

Number 57 on your Feedback card

Hams with Class

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Dayton HamVention '97

I dipped into the resource pool of the most talented hams I know, and came up with a winning combination of guest speakers for the Instructors' Workshop at Dayton this year. It was a pleasure dealing with every one of these people, because besides being good friends, they each excel at what they do.

The purpose of this forum is to give creative ideas to teachers and instructors about recruitment and about how to give highly motivational ham radio lessons. It was impossible not to get a ton of good ideas from these speakers.

Bob Grove WA4PYQ is a long-time friend who has shared many a podium at radio conventions with me. Bob is the publisher of *Monitoring Times* and *Satellite Times* magazines. His talk was on "Using Shortwave Radio in the Classroom." Listening to international broadcasts can open the door to lessons in geography, history, current events, culture, and foreign languages. Being a former teacher, Bob is very well aware of the value of using radio to motivate kids to learn about their world.

Bob Heil K9EID always enthralls the audience whenever he speaks about his two favorite topics, ham radio and teachers. Bob is the author of several books about sound systems. He is a world class expert on this topic. His demonstration on how to teach about phasing brought the house down. Bob exemplifies everything a good teacher or instructor should be. He is dynamic and creative, and obviously feels he owes a lot to ham radio for being so instrumental in his chosen career.

Seth Foote KC8BUD and David Force KB8TDB are two delightful students from Troy High School and Troy Jr. High School respectively. The entire audience was so impressed with them both. They spoke about "Working Emergency Radio Stations" and "How To Establish A School Station." They gave excellent pointers to teachers in the audience about how to approach school administrators. They even had a videotape presentation of the principal who enthusiastically endorsed their management of the school's ham radio station.

Henry Feinberg K2SSQ (**Photo A**) is a noted inventor, writer-director, and creator of the ET communicator. His talk was "Creativity 101—From Foxhole Radios to Imagineering." Henry dragged his Rube Goldberg creation in a suitcase all the way from New Jersey. He had a most unusual demonstration for us. The point of showing his elaborate concoction that eventually boils water for coffee at the end was to discuss "functional fixedness" as an educational concept. In order to stimulate students to be creative and inventive, a teacher should encourage projects like Henry's which force you to use commonplace objects in ways other than what they were intended for. He really made his point very well.

Dave Bell W6AQ (**Photo B**) is a Hollywood director and world-class DXer. He spoke about "Effective Uses of Dxing in the Classroom."

Dave brought along some of his more exotic QSL cards and suggested ways of using them on display to motivate kids to want to make distant contacts. The application of geography and social studies skills to radio contacts was discussed. Bringing in guests from foreign countries who were just voices on the radio is a fun activity, too.

Bill Pasternak WA6ITF is the producer-writer of "Amateur Radio Newsline." He spoke about one of his favorite enterprises, the "Young Ham of the Year" award. If any of you are aware of an accomplished young ham radio operator who might make a good candidate next year, please get in touch with Bill for an application form. He can be reached at [BillWA6ITF@aol.com].

Photo B. *Dave Bell W6AQ spoke about the effective use of DXing in the classroom.*

The workshop was a big success simply because so many folks in the audience asked great questions and were able to walk away with some excellent, fresh ideas for the classroom. My thanks to all the terrific speakers.

Photo A. *Henry Feinberg K2SSQ made his point about "functional fixedness" very well.*

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
E-mail: [Homingin@aol.com]
Web: [http://members.aol.com/homingin/]

Creativity runs rampant

Ham radio is a wonderful outlet for creativity. From simple circuits to complex systems, such as linked repeaters and APRS networks, hams use imagination to design and implement novel solutions to communications needs. Nowhere is ham radio creativity more useful than in the sport of finding hidden transmitters, often called foxhunting or T-hunting.

Seldom will you find two hams with identical radio direction finding (RDF) installations. Each setup is the result of the ingenuity of its owner. Creativity also comes into play when ham clubs decide what kind of T-hunts to hold. The basic format in the USA calls for all teams to drive as close as they can to the transmitter, then finish the hunt on foot if necessary, but no two groups have identical hunt rules. They differ in number of transmitters, boundary size, signal timing, scoring method, common starting point, if any, and restrictions on location and movement of the transmitter. Some hunts are highly structured, while others are virtually "no holds barred."

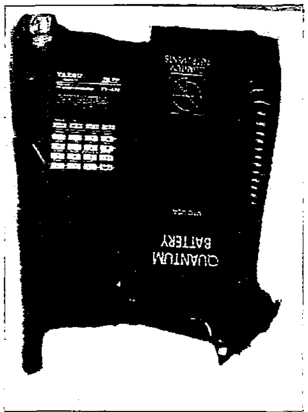


Photo A. This hidden transmitter lived up to the name. Darryl Widman KF6DI hollowed out a thick telephone book to conceal his handie-talkie and battery pack. This book was in plain sight under a pay phone at a hamfest, but many hunters ignored it completely while T-hunting only with their eyes.

The greatest opportunity for creative expression comes when it's your turn to "hide the fox." Within the rules of the hunt and the constraints of equipment and wave propagation, your mission is to befuddle and amaze your fellow hunters. For a hunt that will be remembered and talked about for a long time, make sure it has a surprise ending. A bit of deception is ideal, so long as it is within the rules and done in good taste.

There are four basic ways to add to the difficulty of your hunt:

- Deceptive signal parameters
- Indirect signal paths
- Apparent inaccessibility
- Concealment and camouflage

You probably won't want to use all these elements at the same time. After all, you don't want the hunt to go on forever, right? Consider the temperament of your local hams. Some take a dim view of hunts that are "too hard" or "too long," while others expect nothing less than your most devious efforts. A series of very hard hunts might discourage fledgling hunters and decrease the number of future participants. On the other hand, no hider wants everyone to show up in half the expected time, demanding that someone go out and hide another fox.

One continuous transmission with constant power and antenna polarization is easiest for hunters. Changing any or all of these signal parameters, if allowed by the rules, adds to the difficulty and lengthens the hunt.

In many parts of the country, short infrequent transmissions add spice to RDF contests. When the signal is on for only 15 or 30 seconds every three to five minutes, hunters tend to scurry around and hunt with their eyes on first-finisher-wins hunts. But when the winner is determined by lowest elapsed mileage, they may sit and wait for transmissions, making the hunt unnecessarily long.

For RDFers using beams and S-meters to get bearings, short transmission bursts can be very difficult to track. Amplitude variations make it even harder. The most difficult signal I ever had to track with a beam/S-meter setup was on a hamfest hunt when the hider switched the T on and off every half second, and every burst was at a different randomly-selected power level. Of course if everyone in your group hunts with Dopplers, this stunt won't slow them down much.

Dopplers aren't invincible, though

Depending on the Doppler array design and local terrain, they can be flummoxed by horizontally polarized or moving signals. How about switching between two separated transmitting antennas, or having a big chunk of metal or foil moving about near the transmitting antenna? The switching or motion should be rapid to fool Doppler hunters, or slower to bollix the beam turners.

An excellent example of this type of trick is the infamous wind-powered dipole invented by John Garrett WN9T of Boston. "It's a device of pure evil," he gloats. "I still laugh out loud when I think of it." Several southern California hams have transmitted through motorized beam antennas that are turned like a barbecue spit to constantly change the direction or wave polarization of their hidden foxes.

Bounce that signal

As you learned when you studied for your ham license, VHF radio waves travel line-of-sight. They are scattered and reflected by hard objects bigger than a few wavelengths. Your RDF gear tells the direction of the incoming signal, but a good hider can use these properties to see to it that the direction of the signal isn't constant and isn't necessarily the same as the direction of the transmitter.

Putting your foxbox downtown among tall buildings may give fits to hunters as they try to separate the direct signal from the bounces. Pointing a beam at heavy traffic or a busy railroad yard adds fluctuating levels to the reflections. The effect is even more pronounced when the hunt is on the 223, 440 MHz and higher bands.

"Those metal block buildings in industrial parks really scatter the RF," says David Croll KT1X. "Also high power and a beam near a river can cause a hunter on the opposite shore to receive strong signals and lots of reflections. You can get some hunters to spend a lot of time looking for the fox on the wrong bank when the signal is so strong that they can hear it without an antenna on the radio. Of course it is best done when there is no nearby bridge!"

If you live near the mountains, you can really think big. A snow-covered peak is an amazingly good VHF reflector. Many of them bounce signals pretty well without snow, too. Brian Mileshosky N5ZGT, winner of the 1997 Newsline Young Ham of the Year Award, reports from Albuquerque that the Sandia Crest plays a big part, so to speak, on their T-hunts. Though far to the east outside the hunt boundaries, he says, "We use it as a huge reflector. The transmitter may be on the far west side of town, but some hunters (I've done it) will end up hiking around the Sandias ... until they get to high elevation and point their beams west."

Mountain bounces play a big part in the T-hunts of southern California. A two-watt transmitter and 11-element beam is all it takes to put out a booming reflection from Mount Baldy. Usually it is impossible to hear the direct signal unless you go up the mountainside or go away from the signal bearing and get into direct signal range.

Bob Thornburg WB6JPI tells of long-distance hunts with transmitters near Bakersfield or in the desert over a hundred miles from the Los Angeles starting point on the other side of a mountain range. He wrote, "The hider places a long horizontally-polarized beam about a foot above ground on a very flat piece of

land, like a big field. The beam is pointed at an 8000-foot mountain from 10 to 20 miles away. The signal illuminates the top of the mountains and diffraction ensures that it will be heard on the other side.

"Of course the signal is quite loud from the reflection off the mountains on the transmitter side," he continues, "but except for a range of about five miles around the transmitter, the direct path is over the horizon and quite weak. If the mountains have access roads, hunters will go up there and get good direct bearings. If not, they just mill around the base of the mountains, quite confused."

You can't make a transmitter completely inaccessible without breaking the rules, but perhaps you can make hunters think it is. A favorite trick of southern California hiders is to find an out-of-the-way fire road or truck trail in the hills. Of course it's not on the map and the entrance to the road is miles from the transmitter in a direction where there is little or no signal to encourage hunters to take the road.

WB6JPI recalls one Los Angeles hunt where the rules called for the transmitter to be within 20 feet of a paved road. It was indeed just 18 feet away, but the only way to reach it was to enter the Los Angeles River five miles away and drive down the paved riverbed to a parking place underneath the Pasadena Freeway. This channel is nearly dry during the summer months—it's even used for bus driver training. But was that really a T-hunt, or just a road hunt?

Hard-to-reach foxes are a specialty of hiders in Melbourne, Australia. "One was at a small pedestrian walkway built under a freeway," writes Bruce Paterson VK3TJN. "It dangled on a rope from a walkway just above the junction of a creek and a river. Hunters arrived on each of the three possible river banks, only two of which had access to the walkway, one going through a school."

It's possible to take inaccessibility too far. WB6JPI tells of a T that was under the rear bumper of a California State Police car parked outside the downtown office. "The engine was running, but the car was unoccupied," he says. "Whenever anyone got near the car, the police would run out of the office and shoo them away. The bearings from the dozen hunters all pointed at that car, but no one could approach it. By some prearranged signal, the police came out and turned off the engine. Then we could approach the car and quickly found the transmitter." Some groups like this sort of T-hunt, but others try to avoid them by writing rules that call for the transmitter to be in a place that is readily accessible to the public and where persons can get to it safely.

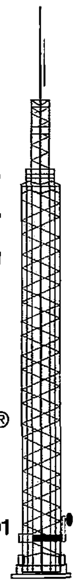
Hide in plain sight

Transmitter hunting is an RDF exercise, not an eye test. Good hunters have trustworthy gear that will find the signal source no matter how well you conceal it. Still, it's lots of fun when the transmitter is cleverly disguised.

The T-hunters of Melbourne are masters of camouflage and concealment. VK5ZCF writes, "We got a large sheet of cardboard and glued old Coke™ cans, newspapers, and other junk to it. We positioned the transmitter and live operator inside a dumpster with the cardboard on top. We even had a few rotting banana skins atop the mess to discourage anyone from digging deeper. Many teams circled the bin ten or twelve times and still did not find us."

VK3TJN adds, "One team built a mini-fox into a brown plastic duck. They controlled the duck's movement through a flock of real birds using underwater string. Another team put a foxbox in the briefcase of a well-dressed businessman standing at the bus stop in a busy shopping center carpark.

"In Melbourne, there is a trendy place called Lygon Street with many restaurants and coffee shops," Bruce continues. "The fox was a fake traffic counter chained to a light pole. The antenna was RG8 coax laid across the busy street pretending to be the air hose. It was very amusing to watch as we sipped our coffee nearby. One team parked on top of the coax and dropped a runner who took off somewhere and was not seen before the end of the hunt. Things were wonderfully confused by the fact that a Met bus stopped on top of the coax just as the teams started to arrive."



Just as with inaccessibility, it's possible to get carried away with concealment. A hider in southern California left his T in a crowded entertainment area of the Disneyland Hotel complex, much to the rage of security officers. Tom Geletka N9CBA of Chicago says, "One joker put his foxbox in the middle of the audience at a large fireworks display, which encouraged hunters to jostle and step among the seated crowd." Tricks like that take the fun out of the hunt. They aren't good public relations for ham radio, either.

Another way to conceal a transmitter is to make it one of a large number of similar objects. KT1X recalls a fox in a company rental car, a new Ford, parked neatly in row of similar new Fords at a dealer on a divided highway on one of the busiest roads in Massachusetts. If necessary, make the similar objects yourself. Bruce Paterson tells of a T buried under sand on the beach. "There were also about forty other antennas of various shapes and sizes, yagis, quads, halos and verticals, all sticking out of the sand in a small area. Each antenna had coax, or wire that looked like coax, attached to it and buried under the sand. Only one went to the transmitter."

Bruce also reminisces about a mobile hunt in an car unknown to the hunters. "The rule for the hunt was that the teams had to flash their lights at the hider's car and announce their callsign on the liaison channel. We would penalize them if we heard a call but saw no flashed lights. What we didn't tell them was that we had three other decoy cars, all bristling with antennas, circulating in the area. Of course every hunter fell for it and was penalized."

I have barely begun to list all the devious ways to add fun to foxhunts in your area. I have some more excellent examples of deception that will have to wait until next month.

How will you use your creativity when it's your turn to hide? Just remember that as you are scoring the hunters, they are judging you. When you think you've figured out the ideal hiding spot and deception plan, stop and ask yourself: Is it clever? Is it fair? Is it safe? Is it *legal*? Will the hunt be fun for all?

Some of the tales in this month's "Homing In" came from a recent discussion of sneaky hiding tricks on the Internet fox-list reflector. (Thanks, folks!) To find out how to get on this list and to learn about T-hunting opportunities in your area and everywhere else, visit the "Homing In" site on the World Wide Web. The URL is at the beginning of this article. Then E-mail news and stories of your hunt activities to me, or you can mail your stories and photos to my post office box in Fullerton.

Photo B. *Would you suspect that a "bag lady" in a mall parking lot could be on the hiding team? Christie Edinger KØIU gave a performance worthy of an Oscar. Her transmitting gear is under the junk in the cart.*

Number 60 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Color it successful!

For months now, we've been exploring video. It's been fun writing about this intricate topic, and I hope you've been enjoying the exploration as much as I have. This month, we're going to wrap it up. Last time, we were about to delve into the specifics of color recording and playback on a modern VCR. Let's get to it:

When we left off, we'd seen how the chroma subcarrier was simply heterodyned down to a lower frequency to enable putting it on tape without requiring lots of bandwidth. I should have mentioned one detail, though, regarding the phase of the heterodyning (local) oscillator. In early "color-under" video recorders (so called because, after heterodyning, the frequency of the color was *under* that of the FM luminance carrier), the crystal oscillator used for the local signal was left to simply free-run; its phase wasn't considered important. The result was that the phase of the chroma signal applied to the tape was essentially random; it slowly drifted with respect to the horizontal sync on which its reference portion (the color burst) would eventually ride.

In fact, broadcast standards specify a consistent phase, so that the color burst starts and ends at exactly the same point in its waveform after each horizontal sync pulse. TV sets, though, don't really care much about that as long as the phase is continuous within itself (in other words, it has no interruptions), and phase-incoherent color works quite well. Although broadcast engineers always sneered at phase-incoherent machines, they served their market just fine, and ignoring the phase issue kept the cost of the recorders down, albeit not all that much. The only drawback was that editing in color was never perfect, as there could be a severe enough discontinuity in the phase at the edit point that a TV might flash a moment of bad color while it re-locked. Then again, given the helical machines' poor dynamic timebase stability (timing accuracy while the tape was moving), perfect editing was never *expected* anyway.

No such luck

While color-under recording was clearly the right choice for a home video recorder, it just didn't work with the new "azimuth" approach to lower tape consumption, in which the video heads' azimuth was deliberately misaligned between adjacent tracks. Why not?

Azimuth recording depends on the short wavelengths, relative to the head gap size, of the recorded signals; the more of them that fit into the wider-appearing gap of the misaligned head, the more they will average out to zero and effectively disappear. The upshot is that the canceling effect increases with frequency. In an audio recorder, the highs disappear first as you turn the azimuth screw on the head mount away from its proper position, and the bass notes pretty much never go away. It acts like a variable low-pass filter.

In a color-under video recorder, the lowest frequencies recorded are the converted color signals! While the luminance FM carrier may have frequencies ranging from perhaps 2 to 10 MHz, color is recorded in the 600 to 700 kHz range. It's the video equivalent of those bass notes. Compounding the problem is the fact that the color is recorded as a sideband signal, not FM, in order to save gobs of bandwidth (and to simplify the process). Sideband is a form of AM, so it has none of that lovely capture effect of FM; weaker interfering signals don't just disappear. The result is that the deliberate azimuth misalignment made for great luminance—but dirty, interference-laden color.

This problem was the final hurdle to the home video recorder.

A new approach

Sony solved the problem in the Betamax™ format, which paved the way to its tremendous success as the first true home VCR. The answer lay in manipulating the heterodyning oscillator's phase. No longer could the phase be considered inconsequential. By drawing the video heads' tracks on a piece of paper, it could be seen that the positions of the horizontal sync pulses lined up pretty closely next to each other on the tape. By alternating the converted chroma's phase every other line, much as in PAL-format TV signals, and then reversing the whole process on every other field, the adjacent tracks, which typically had pretty much the same instantaneous phase at any given point (since, from field to field, TV signals usually change slowly), could be made to mostly cancel out. It wasn't perfect, but it was pretty good, and the eye's tendency to average noise over time, combined with the averaging effect of the TV's phosphor persistence, made it even better. It was good enough; the color looked clean. (By the way, if you want to see what the signal-to-noise ratio of a typical video signal *really* looks like, take a good look at a still frame. It sure doesn't look anywhere nearly as good as when the tape is moving, does it?)

When JVC developed its VHS format, Sony already had a patent on the phase-alternating scheme, so they had to find another way to do it. The result was VHS's four-phase alternating system, which is similar but rotates the phase through 90-degree shifts from field to field. The visual result is about the same.

The great war

Speaking of formats, the great Beta vs. VHS war illustrates the power of marketing over quality, much as the war between computer operating systems has done in recent years. Although the basic principles of the two formats were essentially the same, Beta was designed to significantly higher video specifications, including wider luminance bandwidth (due to a bigger head drum and thus higher writing speed), more chroma bandwidth (for the same reason), and tighter timebase stability (less wobble), which resulted from the "beta" wrap that put more tape between the supply reel and the start of the head drum. VHS's marketing, particularly in the video rental arena, clobbered Beta. Its longer time on each tape helped, too, because cassettes were very expensive back then, around $18 each, compared to today's $2. Beta fought back with the first hi-fi VCR sound, which was accomplished by putting two FM subcarriers for the sound on the video tracks, along with the video signals. It helped for a while, but VHS soon countered with its similar hi-fi system, and the war was over. People snicker at Beta today, but it *was* a higher-quality format. Many videophiles still prefer it.

Playback

OK, so the now-complex, phase-shifting color-under signal was on tape. How to play it back? Again, heterodyning was used. Here's where the PLL came in. The timing problems were caused by mechanical variances induced by everything from tape wobble to thermal expansion and contraction of the tape itself. The exact timing wobbles were not predictable. How the heck could you compensate for that all the way down to the nanosecond level?

Luckily, there was one aspect of the timing errors that was known: They didn't happen very fast, because the mass of the spinning head assembly provided a flywheel effect that kept things smooth over the short haul. At least, the errors weren't fast relative to the speed of video signals! So, it was a reasonable assumption that the amount of timing error over a single, 62.5-microsecond horizontal line was next to zero; errors were much more gradual than that.

In the early days of color-under machines, various techniques were used to provide a reference signal that could be used to compensate for the errors. Some machines put a "pilot tone" on the tape, along with the other video signals. That signal would, of course, contain all the same timing errors as everything else, and it could then control the PLL circuit to compensate for them. It worked, but the extra signal took extra bandwidth, and it sometimes caused visible interference to the video signal.

In modern machines, the horizontal sync pulses of the luminance signal are used as the reference, so no extra signals are required. Like everything else on the tape, they contain the same timing errors as does the chroma signal. But how could they be used to correct the color?

Mix it UP!

Remember how a balanced mixer works? It produces the sum and difference frequencies of the signals that go into it. Well, if both of the frequencies wobble, say, up a few kHz, what happens? The difference frequency won't, because the changes cancel each other out as long as the incoming frequencies have changed by the same amount. So, the trick is to control the local oscillator, using a PLL driven by the horizontal sync pulses, to make it wobble up and down in frequency, in step with the wobbles of the horizontal sync itself. The local oscillator will then be tracking the tape errors, and mixing it with the chroma signal coming off the tape will produce a stable, corrected, color signal, ready for the TV set.

This crazy scheme works, only because re-correction occurs every 62.5 microseconds, at the beginning of every horizontal line, and nothing much in the way of errors occurs within a given line. In a real VCR, though, it gets pretty complicated. Remember, all those phase shifts deliberately introduced to keep adjacent tape tracks from trashing each other have to be removed, which requires the local oscillator's phase to be shifted in the same manner and at the same time. Also, two loops are required for good

Number 62 on your Feedback card

The Digital Port

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703
E-mail: [jheller@sierra.net]

BayPac™ portable helps diagnose

Last month's column concerned getting the BayPac BP-2M to work with some of the aging and newer equipment in my shack. At the conclusion, the BP-2M was happily speaking digital to the local PBBS through my mainstay Pentium™-based computer. This was fine, but unfortunately that computer resists going portable.

After I worked around certain other obligations, I tackled the IBM laptop conundrum. Why doesn't this thing speak through comm port 2 to the outside world? In the earlier days (before Windows 95™) there was a neat little diagnostic utility that came up in DOS when you typed *MSD*.

Those days are gone since the entry of my new automated operating system. But just for good measure, before the planned call to IBM, I looked at the directory on the hard drive for clues. Nothing remotely resembled a diagnostic helper, but there, in the corner of the screen, was a [readme.txt] file I hadn't read.

A message from on high

Believe it or not, this file was planted there by a sage computer god who knew that I would open it one day—and why. In very plain language, it stated something to the effect that I could not activate serial or parallel ports and several other devices from DOS—I had to go to Windows. The only thing missing that would have made it more personal was my name (and possibly an opinion of my intellect), although I have mentioned this restriction to others and it was news to them, too.

To make a long story short, I followed the procedure to the Device Manager and sure enough, it indicated I needed to check a box to get the port going and then reboot. As I mentioned, the BayCom software is very fussy about having plenty of room to maneuver. It is necessary on startup to hit the F8 function key when the operating system displays that Windows 95 is starting.

This produces a menu from which you can choose plain vanilla DOS. From there you go to the BayCom directory and run BPMODE. This program searches for the modem and tells you which port it is connected to. Voilà! It said the connection was on port 2. This exercise was beginning to make me wonder: How close is the day when the intelligent computer will take us by the hand and solve all of life's problems?

This was great. I now had a laptop that conversed with a modem attached to a handheld, a very portable packet station. (See **Photo A**.) I had wanted one for years. I connected to the local PBBS, read my mail, sent a message of my own, and scanned the bulletins. The radio-digital life was looking up.

Search for a Windows program

But it wasn't quite enough. I could live with this, but I use the computer for activities such as writing this column, and just about everything else I do uses Windows applications. I needed a Windows program that could speak the BP-2M language, at least for packet. I have had a few inquiries about such combinations and felt some responsibility to provide the answer.

In a newsgroup a week or so ago, I ran across an opinion that nothing worked with these little modems (not even DOS). There was a posted answer that appeared very complicated, but if that was what it would take, I was prepared to take the plunge. However, there were some simpler avenues to follow first.

I had experimented using several programs with the BP-2M. The next step was to look to see if one of them would be successful before embarking on another long journey. In the laptop's hard drive there was a program I had downloaded in a directory that is self-explanatory, WINTNC. The program is available on the TigerTronics™ Web page.

Upon bringing this up and checking it, all the parameters were in order, so I connected the BP-2M to the radio and applied the antenna. In my shack's location, one and a half watts doesn't make it out without an outside antenna. The *Connect* command keyed the radio and the little station was on the air with a Windows program.

One little problem

The PBBS didn't respond, so I assumed it was down. I sent a connect to a node that is thirty miles off in the other direction off the back of the yagi and it came up. Not bad. Just to be sure it wasn't a fluke, one-time-only acknowledgment, I worked a few of the commands on the node and even connected to another node. It was real—the little station is a success.

Then the plot began to thicken. The next day, I decided it was time to experiment with the HF rig. After all, this BP-2M is a multimode unit. If it is working in one area, it should easily expand into RTTY and AMTOR and the

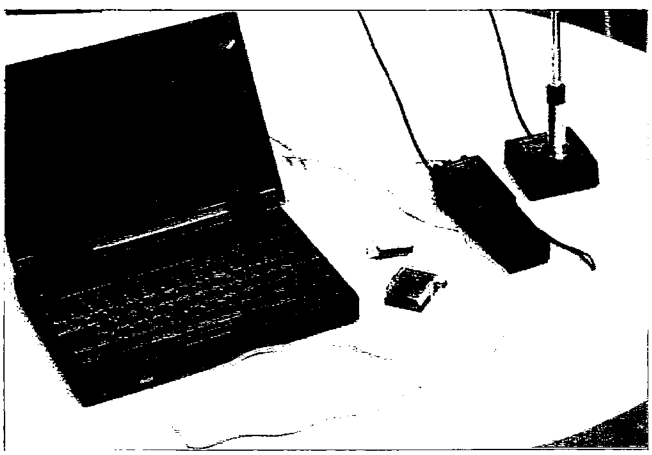


Photo A. The KB7NO portable packet station, ready to plug and play. The BP-2M is only slightly smaller than the cable end that plugs into it. The cable to the radio is regular phone cable and uses the same plug into the BP-2M as connects to a standard telephone. Power source for the BP-2M is the serial port. With a good 12-volt source and a Radio Shack™ inverter for the computer, the station can stay on the air indefinitely.

color. The first is a frequency-correcting loop that fixes the gross frequency errors induced, for instance, by scanning the tape through those pesky commercials, or by large temperature variations. The second loop is a phase-correcting loop which corrects the small errors caused by tape wobble and such. Luckily, all this mess now comes on a chip or two, rather than the big board full of hundreds of parts it once took.

Now that we've delved into its depths, I hope you can see why the home VCR was such a monumental achievement. When first conceived, the technology of the day simply couldn't support such a product. The demand was there, so technology was forced to catch up. And it's been catching up, faster and faster, to the demand for more and more complex gadgets—from nearly wearable, full-featured micro HTs to digital camcorders to gigabyte hard drives that fit in notebook computers (not to mention the notebooks themselves). We owe a great deal of the advancement in our consumer electronics to this one amazing product. And you can get 'em cheap at hamfests!

Next time, something different. Until then, 73 de KB1UM.

other modes. It didn't take long to make a cable to match up to the accessory jack on the back of the ICOM 735. It only takes four wires for the connection, and the socket on the BP-2M accepts a regular telephone connector. I seemed to remember having a few of those around the shack.

The software supplied with the modem is Hamcomm™ shareware and it, too, runs in DOS with the same restrictions about Windows not running. I can live with that; this will be a snap. I printed the manual and scanned through it for warnings and specific hazards to avoid. There is a configuration file to edit; it is straightforward with the instructions imbedded. Got that done and it was ready.

Applied power, tuned around 20 meters for signals, and heard nothing in the modes this would copy. There were a few PACTOR signals and a little CW. If all is quiet, it is time to make a little noise of our own. The program appears to work, there are correct sounding signals for RTTY and FEC coming from the computer speaker, but the radio PTT is never keyed (grounded). Jumping the PTT terminal to ground keyed the rig.

I checked the other connections and remembered an item I had passed up. This modem is not quite as magic as a PK232. It is necessary to bring up BayCom's BPMODE and change the mode from packet to multimode. That done, there was still no action on the PTT. Just couldn't get the signal on the air.

Possibly, I had mutilated the little modem. It wouldn't take much. Anything that will function on the power available from the serial port is pretty fragile. So I went back to the mode that worked, packet, after resetting the modem to that mode. I brought up the local PBBS and breathed a sigh of relief. At least the problem wasn't toasted hardware.

The Windows enigma

Then I realized that since I had followed the natural scheme of getting packet up and running, the computer was using the DOS program. I was curious about whether there was a problem when running Windows. After shutting down the computer and bringing up Windows 95, I found that the WINTNC program functioned, but there was no connect.

Watching the radio closely, I saw the transmit LED light, but there was no receive action whatsoever. For some reason, the PBBS system, where there had been a rock-solid connection just a few minutes previously, would no longer acknowledge my connect requests. Same hardware, just a different operating system and program.

Several possibilities occurred to me. If possible, I like to do a little overkill with stubborn problems. I took the laptop, handheld, modem, and connectors out to the van in front of the house. The van has an auxiliary battery with 12-volt outlets for just such use. With everything hooked up, the handheld gets a boost from the 12 volts. So the real differences were five watts and a whip antenna.

The PBBS responded the same way from that location. The next step was to move into a line of sight position within a mile of the station. Still the same. Experimenting with some of the parameters, there was one fragile connect made, but after a disconnect, it could not be duplicated with the Windows program.

It would seem that about everything had been eliminated except that possibly the Windows program wasn't sending a clear tone. So I tried the node that is off in the next county with the Windows program. After a few retries the connection was made. It was a little shaky because of the path and it was fairly busy.

Taking advantage of mobility

Driving the nicely portable packet station to the other side of the hill knocked off about five miles and made the remaining 25 miles a straight path. The node came up first try and responded like it should.

There are a number of unanswered problems here. I guess I should feel glad that these little challenges keep tracking me down. They certainly make life interesting. I didn't throw in one other confusing parameter. When the packet connection doesn't

Continued on page 78

Number 64 on your Feedback card

Ham Radio Fun

Communications Simplified, Part 22

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

Previously, we said that telephone companies use µ-law compression to provide 13-bit accuracy with just 8-bit data. This varies the step size, to give small audio signals better resolution. Unfortunately, this converts some incoming digital data into voltages so small that they are corrupted by noise. To avoid this problem, the ISP (*Internet service provider*) sends 7-bit data, rather than 8-bit data. This results in 128 voltage steps rather than 256, eliminating the 128 smallest voltage levels—the ones that cause the most problem with noise. Alas, this reduces the data rate from 64k bps to 56k bps. (Actually, because of limits on maximum allowed signal levels, the actual speeds are closer to 53k bps.)

What if you want to go faster than 53k or 56k bps? If eliminating the analog signal at one end of the circuit speeded us up to 56k bps, how about eliminating analog from both ends? Now we're on the right track.

Let's examine the POTS a bit more closely to see how this can be accomplished.

Your telephone set

Also called a subscriber set (part of the CPE or *customer premises equipment*), your telephone is an analog instrument which converts between sound and electrical signals. In addition to the microphone and earphone, the telephone set also contains the dial (either a pulse dial or a tone dial which emits DTMF—*dual tone multiple frequencies*) and a bell (called a *ringer* in telephone parlance). **Fig. 1** shows a bit more detail.

When you are not using the telephone, the hook switch (switch hook in telephone talk) is open, and only the ringer is connected to the line. A capacitor in series with the ringer prevents DC current flow through the line; the telephone company rings your phone by sending an AC ringing voltage of 100 volts at 20 Hz. When you pick up the handset to answer, the hook switch closes, and DC current can pass through the telephone. This tells the telephone company that you are there, so they turn off the ringing signal and complete the talk circuit.

The local loop

The local loop is the two-wire twisted pair of copper wires which goes from your house to the telephone company. At your end, the wire typically ends at a demarcation jack, which is the boundary between the inside wire (which you generally own) and the outside line (which belongs to the phone company).

At the other end, this wire generally enters the telephone company's central office or CO, which is where "The Switch" is. More on this later.

Most often, the local loop goes all the way from your house to the CO, although it may not be one continuous piece of wire. There are probably quite a few splices along the way, where your single twisted pair connects into a small multi-conductor cable, and then perhaps to larger and larger cables (containing hundreds of other pairs) before it reaches the CO.

But there are a number of other possibilities. A large cable, and the work involved with installing and splicing it, is quite expensive. Quite often, especially in large office or apartment buildings, or in housing subdivisions, part of the connection is through an optical fiber. In that case, the copper-wire local loop may go just part of the way toward the CO, at which point it enters a multiplexer which combines your signal, along with those of many others, into a single optical signal on a fiber.

One of the current buzzphrases is "fiber to the curb," which implies that the fiber may go directly to your street or neighborhood before it is split up into copper-wire local loops to individual homes or offices. Telephone companies are installing fibers partially to lower costs, but also partially because they are looking to the future. Optical fiber has vastly larger bandwidth, and can be used to provide all sorts of new services in the future without requiring that the entire neighborhood be rewired. There is also another reason—copper is expensive, and in some neighborhoods, often stolen. Fiber cable, on the other hand, has no value to thieves and will (hopefully) last longer.

But back to the local loop. The copper side of it is an unshielded pair of (generally) 24- or 26-gauge wires. It is a balanced and twisted pair; the balanced connection helps to reduce the pickup of

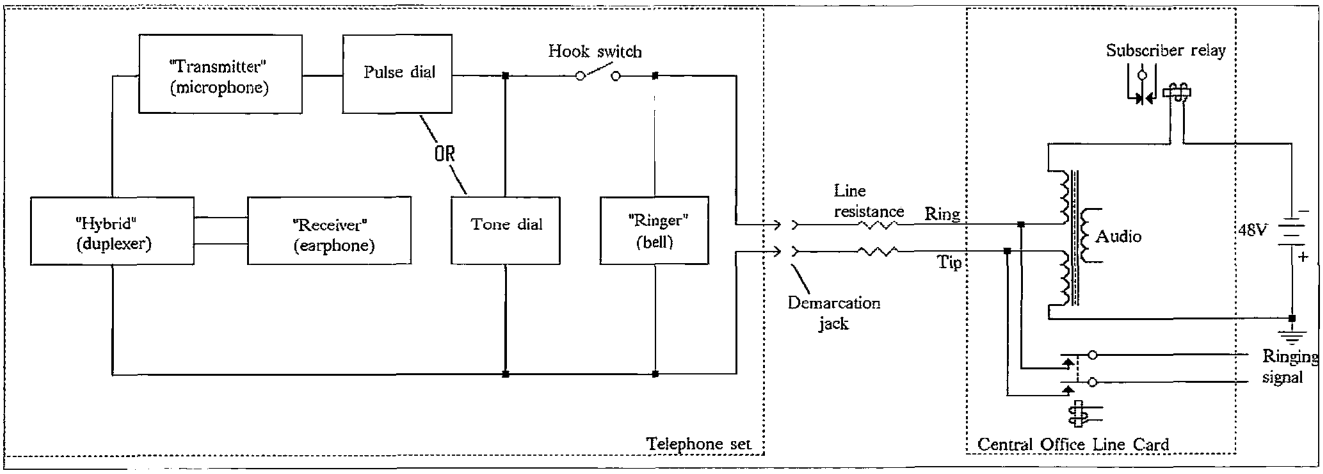


Fig. 1. How your telephone company connects to the CO.

outside noise and hum, as well as crosstalk from other, adjacent wire pairs. The loop is balanced only for AC signals; in terms of DC, it is not balanced because the positive side of the battery is grounded at the central office. But it is the AC balancing that is effective in cutting down noise and interference.

Because the wires are thin and close together, there is a sizable capacitance between them. This makes the circuit into a low-pass filter, which reduces the high-frequency response. Even with short cables, at just 3000 or 3500 Hz these high frequencies are attenuated and result in a noticeable lack of treble. The curve labeled "plain line" in **Fig. 2** shows the typical frequency response of a local loop several thousand feet long.

In order to improve the high frequency response, the telephone company therefore often inserts loading coils into the local loop. These are toroidal inductors, most often 44, 66, or 88 millihenrys, which are connected in series with the line. These are not as common in large cities, where the distance from your phone to the nearest CO may be fairly small, but appear quite often in the suburbs or out in the country.

The loading coil is also sometimes called a peaking coil; it resonates with the line capacitance and produces a peak in the frequency response somewhere between 3,000 and 4,000 Hz; this increases the high-frequency response of the line, as shown in the "with loading coils" curve in **Fig. 2**. But you can see that, although the loading coil improves the frequency response in the high audio range up to about 3,500 Hz or so, it actually makes things worse above that. (It also affects the phase of signals.) Signals above 4,000 or 5,000 Hz have almost zero chance of getting through now. Thus pure digital signals (with rapidly rising edges and plenty of harmonics) have no chance of getting through either. From a voice point of view, this is just fine, however.

The central office

The central office is just the beginning of the path through the POTS system; we have already showed a very simplified picture in **Fig. 1**.

In the central office, the hybrid and the two analog/digital converters reside in "The Switch." The switch is the device which directs your call either to other phones serviced by your local CO, or to trunk circuits, which send it out to other telephone companies or other central offices. Years ago, switches were electromechanical monsters; today's switches are specialized computers.

Most of the circuitry in the switch is common to all users, but some circuitry must be duplicated for each line. As a result, all the incoming local loops terminate in line cards, which handle just a small number of subscribers each. For example, the circuitry on this card monitors your line to see when you pick up your phone. **Fig. 1** shows a simplified picture of how this is done—a subscriber relay, connected in series with your line, detects the current that flows when you pick up your phone; it then signals the switch that your line needs attention. Likewise, a relay connects the ringing signal to your line when needed. The typical line card also has a transformer which couples the audio to and from your line.

But **Fig. 1** does not show the circuitry on the other side of this transformer. This circuitry includes primarily a hybrid, which separates the incoming and outgoing audio paths; an anti-aliasing filter and analog-to-digital converter, which converts your voice into PCM coding; and a digital-to-analog converter which converts incoming digital data into the audio that is sent to your phone.

Technicians often use the word **BORSCHT** to remind themselves of all that the line card does. These letters stand for the following:

•**B**attery. It provides -48 or -50 volts DC to your line.

•**O**vervoltage protection, to protect the switch from lightning, short circuits to power lines, and similar problems.

•**R**inging. It provides the 100-volt 20 Hz ringing signal to ring your bell.

•Supervision. It monitors the DC current through your line to determine when you pick up your phone.

•Coding. The analog-to-digital and digital-to-analog converters, as well as the necessary anti-aliasing filters.

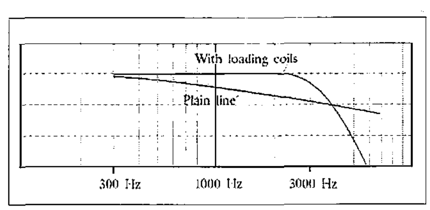


Fig. 2. Effect of loading coils on loop response.

•Hybrid.

•Testing. The line card allows the switch to perform various testing on your line to make sure all is well.

Although it does not concern us right now, let's list some of the switch functions anyway, just to give a more complete picture:

•It detects and records the number you dial.
•It figures out how to make the connection.
•It connects your call to other parties or circuits.
•It keeps a record of the calls you make.
•It provides extra functions, such as call waiting, call forwarding, or caller ID.

The switch belongs to your local telephone company (which is now called the LEC or *local exchange carrier*). It is located in the central office, and can typically handle several tens of thousands of lines.

When you make a call, the switch analyzes the number you dial, and passes your call on. If you dial someone who is also served by the same switch (typically someone else in your neighborhood), the switch simply connects your call to that line. Otherwise, the switch connects you to other switches. These will generally be owned by the same LEC (for calls within the area served by the LEC) or an IXC (an *inter-exchange carrier* who handles long-distance calls).

The effect on digital signals

The reason for this discussion is that it has an effect on how digital data can be sent through the telephone network.

Years ago, the switches were all electromechanical. The analog signal on your local loop went directly to the switch, which kept the signal in its analog form. Connections between switches generally remained analog, though in some cases the audio signal might be modulated onto a carrier for transmission on a long-distance cable or microwave network. Although early ESS (*electronic switching systems*) used digital computers for control, they still kept the signals in their analog form.

Today, however, things are different. Except for very sparsely populated areas (and many foreign countries), the latest generation of switches is now completely digital. The audio signal from your local loop is converted to a digital signal as soon as it enters the switch's line card; in fact, if part of the connection from your house to the switch is through an optical fiber, then the conversion from analog to digital is done out at the multiplexer, even before the signal reaches the switch.

As we discussed previously, the sampling rate for this conversion is 8 kHz; hence an anti-aliasing filter is needed to absolutely remove any audio signal above 4 kHz before it hits the analog-to-digital converter. It typically removes any audio above about 3,400-3,500 Hz. Thus there is no way that any fast digital signal will get past the line card—which explains why you need a modem to call another computer.

But ... the copper wire part of your local loop can carry signals above 3500 Hz. How high a frequency depends on the distance—a number of business-type multi-line telephones send a high-frequency carrier signal through existing telephone lines to provide an intercom function between phones in an office. There are also several commercial products which use the telephone wiring in your house to send 4 MHz video bandwidth signals from room to room.

In fact, it is possible to send high speed digital data over the local loop from your house or office to the telephone company's central office (or their multiplexer, if they use an optical fiber part of the way), as long as the distance is not too great (up to about three or four miles). The catch is that this requires your local telephone company's cooperation in three ways:

First, any loading coils in the local loop will kill the digital signal, so they must be removed.

Second, any extra taps (sometimes called stubs or bridges) on your line must also be removed. Telephone wires are often shuffled from customer to customer, reused when circuits are changed, or swapped when bad weather causes corrosion, with the result that there are often portions of open-ended lines connected across (bridged across) working lines. While they do not interfere with normal audio, they do reflect digital pulses, and thus cause errors.

The problem with loading coils and taps, especially in older neighborhoods, is that they are usually not properly documented in telephone company records. Removing them may involve actually sending out a technician to trace your loop from end to end, and to look at each connection along the way. The telephone company will not do this unless there is a good reason.

Finally comes the third way in which you need the telco's help. Being able to send high-speed data to the central office is useless unless there is something at the CO end to process that data. They must install some special equipment at their end to accept that data.

For a price, telcos offer several such services. One of these is ISDN; to bypass the anti-aliasing filter and analog-to-digital converter, which would normally destroy high speed data, the telco can install a special line card which omits these components and passes your digital data directly into their digital network.

ISDN

ISDN—*integrated services digital network* is a purely digital connection from the customer to the central office. It has been around quite a few years, is always on the verge of becoming popular ... and may already be on the way *out*.

As you remember, the normal audio telephone network sends analog audio from your telephone, through the local loop, to the central office, where it is sampled and converted into a digital signal. It is carried digitally from then on, at a rate of 64k bps, until it is converted back to an analog audio signal in the central office at the other end, just before it is sent to the person you are speaking with. The sampling is done at an 8 kHz rate, with an 8-bit analog-to-digital converter, for an effective rate of 64k bps.

ISDN changes the picture a bit by moving the sampling and A-to-D conversion (if you use it for voice) from the central office back to your home or office. It is still done, but it is now the job of your equipment to do it. The local loop then carries only digital data back and forth.

There are two kinds of ISDN: *basic rate interface* or BRI, and *primary rate interface* or PRI.

Basic rate interface ISDN

BRI is intended for the home or small office. It provides two 64k data paths (called *bearer channels*) and one 16k bps *data channel* (plus some overhead bits), all over one pair of wires just like a normal local loop. The system is often called 2B+D for that reason.

The D or data channel is used for signaling between your system and the central office, such as for dialing a number or ringing the phone, but can also handle digital data. Each of the two B or bearer channels can carry one 64k bps voice signal, which makes it attractive from the telephone company's point of view. They can now provide two telephone circuits over one pair of wires.

From a user point of view, there are a number of advantages. Foremost is that, if you call from your ISDN line someone else that also has an ISDN line, the 64k bps data you send out is delivered completely unchanged to the person you called. In other words, you need not use this channel just for voice—it can also be used for computer-to-computer or fax-to-fax communications, or for any other purpose that requires a direct data transfer. If 64k bps is not fast enough, you can bind the two D channels together; that is, you can use the two channels together to get 128k bps data transfer. (But note that this requires that you place, and pay for, two telephone calls, one for each channel. It also requires some additional equipment.)

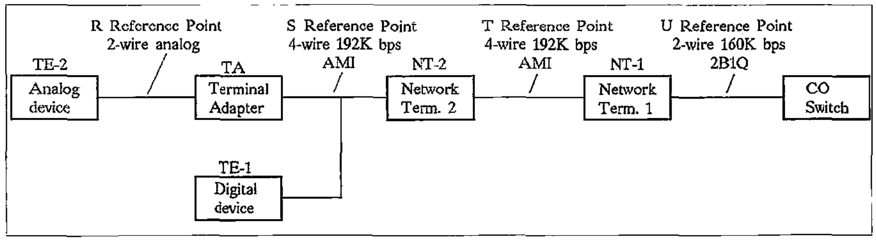


Fig. 3. BRI ISDN circuit.

NT-1 and the U reference point

Fig. 3 shows how a BRI ISDN line can be used. Shown on the right side is the connection between the central office switch and a *network terminator 1* called an NT-1. This is a two-wire line—just like a normal local loop, except that loading coils and any taps must be removed because it carries pure digital data (although short taps are sometimes permissible).

This part of the circuit is called the U reference point or U interface. The line may be up to 18,000 feet (approximately three and a half miles) long. This may create some problems in outlying areas, but there are repeaters that can be inserted to lengthen the line.

The NT-1 terminator primarily terminates the line, converts the two-wire U line to a four-wire system, and protects your equipment against lightning and other faults. It does require power, though, and here is an interesting aspect of ISDN: Normal analog POTS lines are powered from the central office (where the telephone company maintains sizable batteries and diesel generators), and generally work even when there is a power failure in your neighborhood. ISDN lines, on the other hand, do not provide power to your equipment (except in Europe). You must provide your own power to the NT-1 as well as all other equipment at your end. Fortunately, much ISDN equipment provides battery backup for use in emergencies, but this seldom provides much running time. Hence it is not a good idea to rely on ISDN service for your only telephone.

Sending 160k bps digital data through a local loop (especially one approaching 18,000 feet) is not easy, so the designers use a technique similar to that of modems—carrying two bits on each symbol. Each symbol has four possible values, and so the system is called 2B1Q—two bits on one quaternary symbol. In this case, however, the data is sent in pure digital form, with the four symbols being four different voltage levels:

1 0 = +3 volts
1 1 = +1 volt
0 1 = -1 volt
0 0 = -3 volts

Fig. 4 shows an idealized 2B1Q signal on the U interface; it is actually quite distorted by the time it travels down the line. Further, since the U connection is bidirectional, there are two of these signals traveling on the line at the same time. The NT-1 and the corresponding circuit at the CO side, called an LT or *line terminator*, rely on duplexers to separate the signals in opposite directions, and provide echo suppression as well.

Remember that the data rate on the U interface is 160k bps; the 2B1Q method reduces that to 80k baud; that works out to an effective 40 kHz, which is more manageable. You can see this in **Fig. 4:** the first four bits of data effectively define one cycle of the signal; the waveform therefore has one quarter as many cycles as bits.

Worldwide, there is some confusion as to the U signal because it was never specified in the CCITT/ITU—T standard. In the US, the NT-1 is to be provided by the customer, and so the U interface is the demarcation between the telephone company and the customer. In other parts of the world, the NT-1 is provided by the telco, and the demarcation between telco and user comes after the NT-1; the U interface is considered proprietary by the telco. Because of this lack of a U standard, early US ISDN systems used incompatible U interface standards, and so some early NT-1 units do not work on modern systems.

NT-2 and the S and T reference points

The duplexer in the NT-1 splits the 2-wire U signal into a 4-wire system, with one pair in each direction, called the T (or S/T) reference point. At this point, the signal is a 192k bps AMI signal.

AMI stands for *alternate mark inversion*. Here, a 0 is represented by 0 volts, while a 1 is 1 volt; but the ones alternate polarity. That is, one 1 may be +1 volt, while the very next 1 would be -1 volt, and the following again +1 volt. Thus alternate ones (marks) are inverted.

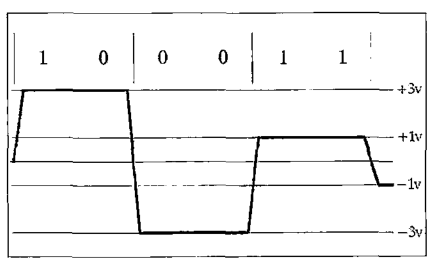


Fig. 4. 2B1Q signal on U interface.

Although this complicates the circuitry somewhat, this scheme has two advantages. First, as in 2B1Q, alternating polarities reduces the effective bandwidth of the signal. Second, if the receiver ever gets two ones of the same polarity, it knows there has been an error; this is called a bipolar violation.

The NT-2 *network terminator 2* is simply a splitter, which splits the T signal into a number of S signals for use by several devices. If the ISDN line is used for only one purpose, the NT-2 can be omitted, since the S and T signals are otherwise the same. In that case, the output of the NT-1 is called the *S/T reference point*.

TE-1 ISDN devices

A number of actual devices can be connected to the S or S/T signals—voice phones, faxes, computer terminals, etc. These break down into two types: ISDN devices are called *terminal equipment* type 1 or TE-1, while non-ISDN devices are *terminal equipment* type 2 or TE-2.

TE-1 devices have a digital interface, and can directly talk to the S or S/T interface. For example, a TE-1 telephone would be a digital phone, which does its own a-to-d and d-to-a conversion.

ISDN fax machines can also be used; as opposed to ordinary analog (group 3) fax machines, the TE-1 machine is called a *group 4 fax*, and it is purely digital. ISDN fax machines are still rare and expensive, but are five to six times faster than an ordinary analog fax machine.

ISDN computer terminals (or computers) require a bit more than just the plain RS-232 interface, because they must be able to command the NT-1 to dial out.

TE-2 non-ISDN devices

TE-2 or non-ISDN devices are the plain old analog kind, like a desk telephone or analog fax machine. Since these cannot talk to a digital S or S/T interface, they need external conversion to and from the digital world. The TA or *terminal adapter* in **Fig. 4** does this job.

There is obviously no advantage in using an ISDN line plus a TA just to use the same analog devices that could be used on a plain POTS line. Still, the TA is useful during the transition from analog to all-digital. It is also potentially useful if the telephone company can only provide one line, yet you need two circuits.

Multiple devices

The 2B+D ISDN line uses just one physical line to connect to the central office, but has three actual logical channels. Each of the two B channels can be used for a separate call (or they can be bonded together for higher speed), while the D channel, although normally used for controlling the B calls, can also be used as a separate data channel for packets. It can therefore handle up to three simultaneous calls.

But the S or S/T interface can handle up to eight different devices. Moreover, from the central office point of view, each of these can have a different telephone number. That is possible today (with distinctive ringing on one line and a corresponding switch box), but ISDN carries it further with more options.

The phrase "multiple devices" has another meaning as well. Although **Fig. 3** shows the TE1, TE2, TA, NT1, and NT2 as separate boxes, a number of vendors are combining them in various combinations. For example, Motorola makes a device called a BitSurfr Pro™, which combines an NT1, NT2, and two TAs into one package. It hooks up to the ISDN line at one end, and provides an S interface plus two analog lines.

Primary rate interface

Unlike BRI, which is two 64k bearer channels and one data channel and is designed for home or small office applications, PRI has twenty-four 64k channels, of which 23 are B channels, and one is a 64k D channel. As with BRI, the D channel is used for control purposes, such as sending dialing data or receiving a ringing signal. PRI is designed for users who need a large bandwidth, or who intend to parcel out the bandwidth to individual users. For example, a common application of PRI is to connect a PBX—a *private branch exchange*, a local switchboard which services a number of telephones—to the central office.

PRI ISDN uses 24 x 64k bps, or 1,536k bps, plus an additional 8k bps for some control information, for a total of 1,544k bits per second. This is too fast for a local loop, and is thus provided over a special connection called a T1 line. As a result, PRI ISDN is generally a service for business, not individuals.

Both BRI and PRI have some interesting characteristics. Unlike a normal analog telephone local loop, where dialing is done with either a rotary dial or a DTMF tone dial (DTMF stands for *dual tone multi frequency*), an ISDN device dials by sending digital dialing information to the switch via the D channel. At either 16k bps (for the BRI system) or 64k bps (for the PRI system), this is much faster than analog dialing. Combined with the speed of today's digital switches, this means that the typical call can be established within a second or two. Moreover, when ISDN is used for digital data, all of the time delays normally associated with modems (where two modems may spend 10 or 20 seconds negotiating what speed and protocol they will use) are not required. Hence it only takes a second or two from the time you place a call until you're ready to send data. It thus becomes practical to hang up a connection, and dial again the next time you have something to send. You therefore need not pay for a call when nothing is being sent.

Likewise, when the switch rings your phone, it does not send the normal AC ringing signal to ring a bell. Instead, it sends a digital code via the D channel. This code not only tells your equipment to answer, but also identifies the type of device it wants to talk to. For example, on a normal analog line, when an incoming call comes in, your phone, your modem, and your fax machine all ring. On an ISDN line, only the device being addressed responds, and does so right away. Again, no delays. 73

Oscillator Basics, Part 3

Frequency synthesizers and you.

Hugh Wells W6WTU
1411 18th St.
Manhattan Beach CA 90266

Although frequency synthesizers were developed about 1930, they were complicated, expensive, and impractical. The advent of digital ICs made synthesizers readily usable. Frequency synthesizers get their name from being able to generate a great number of discrete frequencies with the stability of a quartz crystal while using only a small number of crystals—most modern synthesizers use fewer than three.

The basic principle behind the synthesizer is the Phase-Locked Loop, referred to as PLL. The purpose of the PLL is to operate a self-excited oscillator (voltage-controlled oscillator, referred to as a VCO) at a frequency different from that of a crystal oscillator, yet lock it to the crystal oscillator in such a way that it will have the same stability as the crystal oscillator regardless of the VCO frequency.

Fig. 1 illustrates a basic PLL function by using a VCO operating at the frequency of the crystal and under the direct control and stability of the crystal. Control of the VCO is through the application of a DC error voltage, which is referred to as a "steering voltage." The frequency of the VCO will follow the change in the applied DC steering voltage, which is obtained from a phase detector that provides an output voltage. The output voltage is proportional to the phase angle difference between its two input signals (reference oscillator and VCO). A 90-degree phase difference occurring between the two input signals indicates the VCO is "in lock."

Please note the use of a low pass filter in the steering voltage circuit. The purpose of the filter is to increase the time constant of the voltage applied to the VCO. Without the filter, the steering voltage would move abruptly, resulting in a fast change of the VCO frequency; the phase detector would output a corresponding correction of the shift in frequency. The result would be a wild oscillation of the steering voltage and the VCO frequency. Filtering the DC voltage dampens the oscillation, allowing the steering voltage to provide smooth control over the VCO without overcontrol—keeping loop jitter to a minimum.

When the PLL is used without a "divide-by-N" as in the modified PLL (**Fig. 2**), the VCO must operate at the frequency of the crystal. However, adding a divide-by-N allows VCO operation at any frequency (which can be divided by a whole number) to a frequency which is equal to the reference oscillator frequency as applied to the phase detector. Again, the two signals presented to the phase detector must be at the same frequency and at a 90-degree phase difference to maintain a phase lock.

Fig. 3 goes a little bit further. Add a frequency divider following the reference oscillator to obtain a low frequency, one that will be equal to the incremental frequency steps desired between synthesized frequency changes in the output. A 1 kHz frequency is used as the reference which allows the output frequency to be stepped in 1 kHz steps across the selected frequency band, and in this example, 1 kHz steps across the band from 1 to 10 MHz.

Many schemes have been developed to obtain synthesized frequencies and

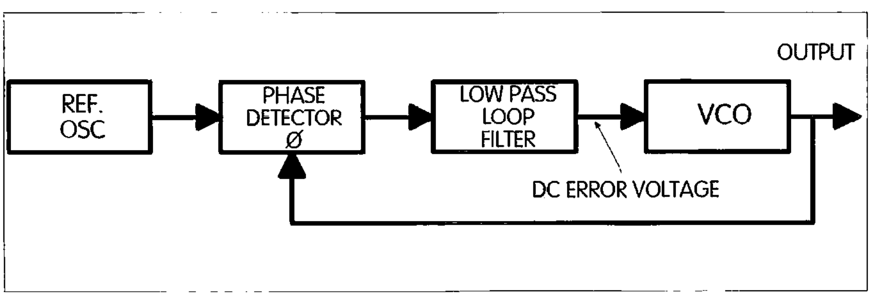


Fig. 1. Basic PLL.

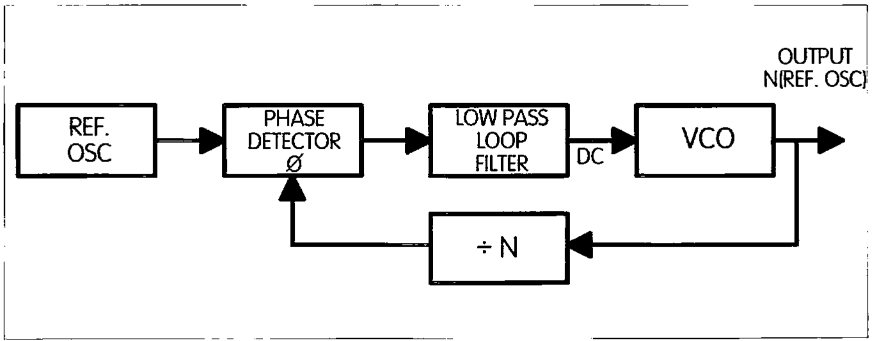


Fig. 2. Modified PLL.

narrowly-spaced steps. One technique is to use a dual modulus synthesizer, which allows over 1,000 discrete frequencies to be generated, while utilizing only one crystal oscillator. The dual module PLL system overcomes the problems of high-speed programmable division by providing near jitter-free control of the VCO while operating at frequencies up to 500 MHz.

Fig. 4 follows the more conventional synthesizer approach, yet is capable of accommodating the frequency offset for operating both a transmitter and receiver on the same simplex frequency. The output of the synthesizer is in the 18–25 MHz range and is expected to be multiplied to the desired operating frequency. Having a 1.66667 kHz PLL increment, the operating frequency step function could be 5 kHz at the desired operating frequency.

Regardless of the synthesizer design, the objective is to lock a VCO to a crystal oscillator in order to obtain the stability of the crystal, but at the desired VCO frequency. The PLL accomplishes its control by comparing the signal from the crystal oscillator to that of the VCO and then steering the VCO frequency to maintain a phase lock which places the VCO at the desired frequency. The frequency of the step function is determined by PLL control frequency applied to the phase detector. 73

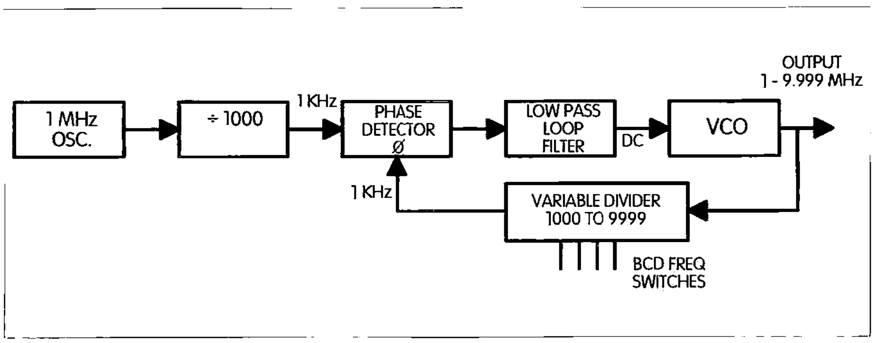


Fig. 3. Basic synthesizer.

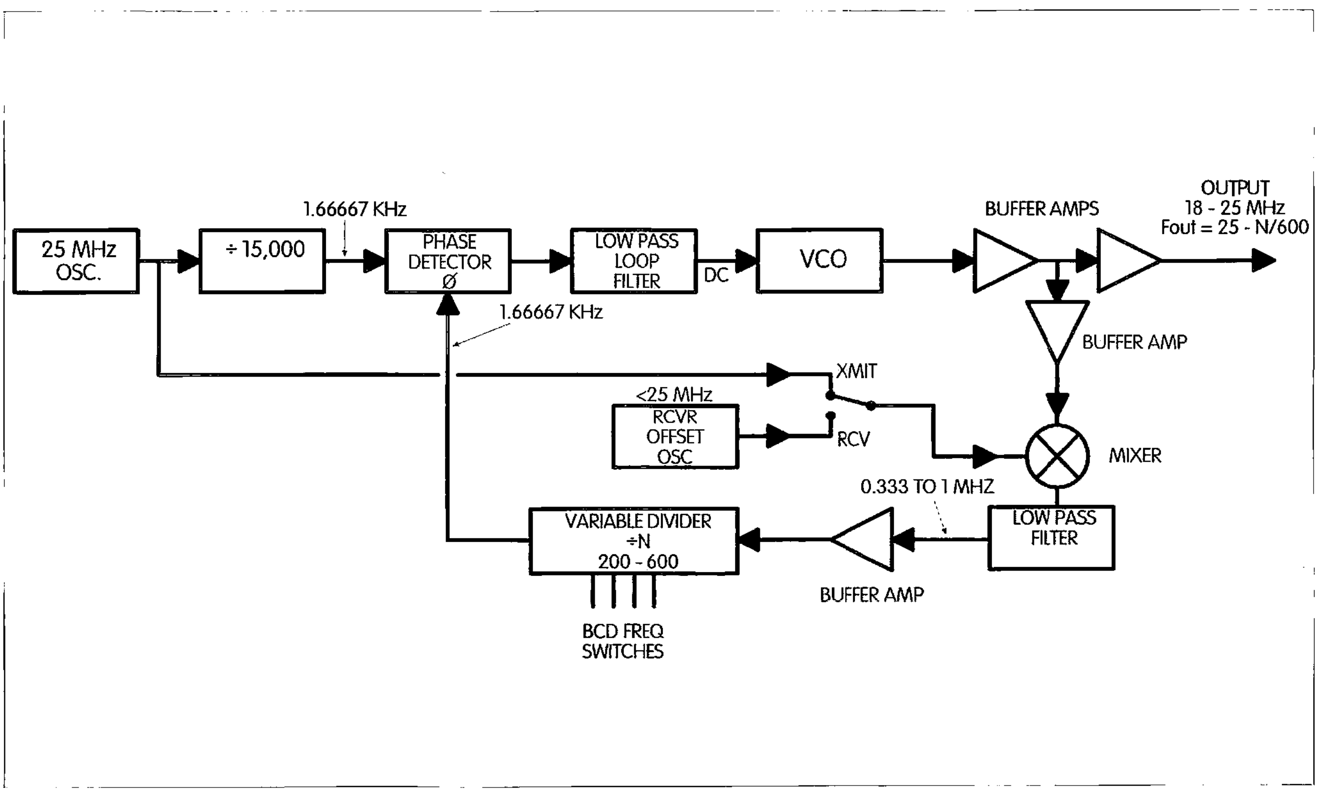


Fig. 4. Basic synthesizer with TX/RX offset.

Still a Great Hobby

Are you a ham yet?

Arthur R. Lee WF6P
106 Western Court
Santa Cruz CA 95060

There is a lot of hype these days over beepers, cell phones, E-mail and—ah, yes—Internet chat rooms. It isn't any secret that these great modern means of communications have arrived upon us like an avalanche of fresh new snow. There's no challenge to checking into a chat room and forming an alliance with a person of like interests, and you don't need an FCC license. A simple computer, a modem and a modest monthly fee is all that is required. Throw in a few hours of "how to" indoctrination and you're on your way. There are horror stories, however, as well as exciting tales of meeting and (even) marrying chat-room acquaintances. With Internet communications, there is a certain "let the operator beware" caution that is inherent with meeting strangers on-line. These strangers have no responsibility to be who they claim to be.

So what about the hobby of ham radio? Let me say that amateur radio is alive, well, and kicking. Nearly every ham operator I know of has an array of communications devices, and uses them all—OK, so we can exclude semaphore and smoke signals!

Still a viable hobby

We hams can and do use everything we can to get our hands on to communicate. CW operators are still around, as are those interested in packet and amateur television (ATV). Recently I was in one of our daily CW QSOs with Marsha Messer AB7RJ, in Washington state. I was transmitting from my daughter's station in Sacramento CA. She has a 100W Kenwood TS-440S transceiver and I needed to send a couple of important messages to other hams. As my daughter's computer was not connected to the Internet, I sent an old-fashioned National Traffic System (NTS) type of message to Marsha. It went like this: "Please pass to AA6ZG in Santa Cruz CA. Will you call so-and-so and tell him that I will not be able to help in the forthcoming VE test session ... " Marsha gave me a QSL, repeated the three-paragraph message, and immediately sent it out over E-mail. My friend Leon Fletcher received the E-mail and made the several telephone calls requested. I received a QSL in return via the same communications route. Exciting? Yes, to me. Practical? Yes, to those involved. Could I have used other means of communication? Certainly, but I didn't have telephone numbers or a list of E-mail addresses with me.

What have we got left?

The hobby is a great and satisfying way to do more than punch keys on a keyboard. The no-code license has brought a rush of new energy into our pastime. Ham radio, formally the domain of electronics technicians, experimenters, engineers, or military and professional operators, is now easily available to the broad spectrum of lay persons. With only a few hours of study, a VHF/UHF ham license can be obtained and a callsign issued, sometimes within days.

Hello to the repeater world!

Almost instantly, by checking into a few repeaters, the new ham can acquire hundreds of new friends. A net directory

Photo A. *On 80 meters, a ham license aspirant carries on a conversation with Joyce KN6RR, in Sacramento CA. The control operator was the author, WF6P.*

will make a cross-country trip an adventure of interesting contacts. A few years ago, while driving our motorhome through Idaho, my XYL (Donna AB6XJ) and I missed our turnoff to Yellowstone National Park. We were engaged in a fascinating 2m QSO with a local rag-chewer!

Links between repeaters permit long-range communications. I once talked to my Navy son-in-law in San Diego from my QTH in Santa Cruz. I used a 2m rig, linked from our local repeater to a string of coastal repeaters. A phone patch connected me to his telephone on his end. Currently, the Condor Net, a 220 MHz link-up, exists and is regularly in use by Gary Baker N6ARV. When on trips he uses it to talk to his XYL, Cathy N6TGL, from Riverside to Watsonville CA, a distance of about 400 miles.

High frequency (HF) and the world

So how about extending our range—and our fun? If that's what you're looking for, old-fashioned HF, whether SSB voice or CW, is the thing for you. Do you like to rag-chew with foreign hams? I have always enjoyed DXing with operators in far away places. Russia? Japan? Europe? Pacific Islands? Antarctica? Ham operators are there just waiting to talk to you. Tune around the dial, send out a CQ, and see what turns up. Better still, listen around the band, pick up a DX station, and respond with your call. For this type of extended communication we will have to get some code (CW) under our belt. Why code? Because it is still required as part of international agreements, and—now get this—it really is fun!

Fear of the code

So what's the hang-up on learning the code? My daughter-in-law, Cybele KC6ZQS, learned the code over a weekend while in our garage retouching the paint on ceramic dolls. OK, so she is a fast learner—but learning the code isn't that hard. With a few hours of concentration, the letters and numbers can be learned. Code tapes or on-the-air listening over American Radio Relay League (ARRL) station W1AW can help speed things up. (Contact ARRL Headquarters, 225 Main St., Newington CT 06111-1494, for times and frequencies.) Code software such as Super Morse© is available for computers. These programs really shorten the learning process.

Testing: easier than ever

So what's left? Volunteer Examiners devote their time to helping hams and hams-to-be upgrade or obtain their licenses. These exams are administered by fellow hams in school classrooms, churches, public meeting rooms, and private homes. For a fee of about six dollars, the examinee can take all the tests from Novice to Extra class in one sitting, if desired. Most of us break the series of exams down into increments, biting off a small chunk of the process each time. Studying for the exam is part of the fun of hamming. Each higher license class is a step to greater learning about the hobby and skills of ham operators. The recognition given by fellow hams as higher license classes are achieved is part of the excitement of the hobby. We have all been through the study phase.

Cost of hamming

Believe it or not, getting into ham radio is actually less costly than getting into computers. These days, most of us purchase a ready-built ham rig, either used or new. Used HF rigs in the cost range of from $300 to $500 can provide years of fun at minimal cost. Throw in another $50 for antenna wire, a couple of insulators, some coax cable, and a ground rod. With these basic materials, a simple dipole can be erected in an afternoon. Other than a negligible increase in your monthly electric bill, that's it! You're in business.

Getting on the air

After receiving your callsign, you're ready to put out some signals. Initially, you may feel some (very natural) apprehension about this. Listen in to other hams chatting away. The communication habits you will pick up shouldn't be too far off the mark. Remember, hams don't bite! Actually, identifying yourself as a new ham is good. Hams love to help people, especially new inductees into the amateur radio fraternity. After a few hours of on-the-air contacts, you will begin to relax and sound just like the rest of us. When will I hear *you* on the air? 73

NEVER SAY DIE

Continued from page 49

and see if you can argue with that nice straight-line curve into oblivion.

Hamfest Report

A note from Dennis WB8QWL of Dentronics, who gets to nearly 50 hamfests a year, suggests lowering the admission price in order to attract more of the general public. He suggests a mailing be made to all local hams, with much or even all of the cost being covered by piggyback ads from vendors. As it is, many hams just don't get the word. Tell 'em to come and explain why they're going to have a great time.

Dennis also suggests that hamfest chairmen start spending money to bring in interesting speakers to discuss antenna design, slow scan, DXpeditions, packet, RTTY, etc. My specialty is "etc."

To attract the public you need to get some of your better talkers on local TV and radio shows, and get as much newspaper coverage as you can. It takes plenty of exposure to make the public aware of both amateur radio and the hamfest. And, when they get there, will they be entertained? What kind of a show is going to be put on for them?

How about the hamfest committee? Are they a group of hams who have a solid record of making things happen? You don't need any "We've never done that before" mentalities. Hamfests are show biz.

Covering It All Up

With all the ado and jokes over the Roswell 50th anniversary, where do *you* stand (or sit) on UFOs? Well, you know where I am on the matter. Between a series of recent TV shows interviewing the citizens and military who were there and are still alive, and their children telling us what their parents told (and showed) them, there's been a steady stream of consistent reports of an Army cover-up of a crashed UFO (or UFOs). This merely confirms the years of UFO reports, as well as the stories from hundreds of contactees.

If Paul Shuch and his SETI group want to find extraterrestrial intelligence, they don't need to listen to their radios, they just need to start reading some of the many books on the subject.

The most recent and best book I've read is Col. Corso's *The Day After Roswell* (which is now on the best-seller list). Here we have the inside story from a high Pentagon official who was the man put in charge of the technology the army retrieved from Roswell (and possibly other UFO crashes). He also personally saw one of the ETs and read the medical autopsy report.

From everything I've read, the visitors (ETs, EBEs, aliens) are eons ahead of us in technology. Corso explains how some of the stuff he had from the Roswell crash helped us develop fiber optics, lasers, integrated circuits, night vision, and stealth planes.

It is interesting that the UFO had no provision for food, water, or waste elimination. It was more like a reconnaissance craft than a space ship. Further, the ETs had no digestive system, voice mechanism or ears. Their ship had no controls or instruments, apparently controlled via headbands worn by the occupants, who were a part of the navigation system.

Since their civilization is very far ahead of ours it might just be that the ETs we've been seeing reported are more like androids, designed as living creatures for this special application. This could also explain the strange contactee reports of the ETs having a hive-like mentality and relatively slow reaction times.

Just as we first sent a robot to explore the Moon, and now have one exploring Mars (I think), perhaps the ETs are using advanced types of "robots" to visit Earth. That could help explain the lack of a digestive system, lungs and other organs which we see in all of our living things.

Corso said the army viewed the extraterrestrial biological entities (EBEs) as hostile, mainly because their ships were keeping such close track of our space program and nuclear weapons developments.

Their lack of a vocal system would explain why contactee reports all claim to have been via mental communication. We have a long way to go in that field, with our researchers seriously hobbled by ridicule, prejudice and little funding.

I've had enough personal experiences with ESP, so no amount of skepticism can convince me that it isn't real. Then there's the amazing research reported by Cleve Backster in his work with plants and then with human cells, showing that in some way our two trillion or so cells are in communication with us, no matter how far separated. This also explains why people with organ transplants and even blood transfusions report memories from the original owners.

You'll get a lot more interesting information on all this if you set up a VCR to record the Art Bell (W6OBB) show every night. He's on from 10 p.m. until 4 a.m. PDT on AM radio. I tape him every night, as I've mentioned, and then listen to the show while collating my booklets and other such grunt work. In that way I'm able to skip all the commercials, cutting down the five hours broadcast I can get here in NH (1210 out of Philly) to half that.

If we were going to design a robot for dangerous missions and able to withstand high accelerations, we sure wouldn't bother to build in a need to provide it food. We would give it a brain so it could think, and enough of a body to move around.

If you are still skeptical about the visitors having been here for a long time, you haven't done your homework.

The military have a vested interest in viewing the visitors as hostile. That gives them the excuse to spend money on more and more advanced weaponry, and money is the lifeblood of any bureaucracy. Why all the secrecy? How are they going to explain the 50 years of lies and cover-up? How can they explain that yes, they think the visitors are hostile, but they have no way to fight against their advanced technology?

Of course there's the FD&H (fat, dumb and happy) approach to dealing with the ineffable. Ignore it and hope it will go away.

How reliable is Col. Corso? Art Bell has had some sterling character references on his program attesting to the fact that Corso was in charge of the army's foreign technology department, and had an unimpeachable reputation. Why has he waited 50 years to blow the whistle? He made a promise to the general who gave him the alien technology artifacts that he would keep the secret until after the general had died. Which Corso has done.

Goldbrick or Lead Balloon?

Have you been goldbricking it through life? Well, that's a lead balloon as far as your learning anything or being at all successful. Yet that's the culture of almost all large corporations and *all* government bureaus, including the post office and all branches of the military. Shut up, don't make waves, and figure out how to do a minimum of actual work.

One of the reasons the Dilbert cartoons and books are so popular is Scott Adams' exploitation of this theme.

In thinking back over the couple of thousand employees I've had over the last 40-some years, I can't think of many who really made an effort to learn and grow. Most people come in to work, minimally do their jobs, and then go home to watch TV. Or bowl. Or even go to or rent a movie.

When I got out of college all of my classmates were busy being interviewed by the big corporations, which were offering great starting salaries. I wanted no part of that baloney, so I went to work as a radio engineer-announcer at WEEB, a small radio station in North Carolina. But instead of settling in to a life of reading commercials and the news, I developed a morning-show format, got busy selling ads, and wrote the copy for shows. I learned how to do every job in the place. But I got tired of getting paid $45 for working 90-hour weeks and went to New York, where I got a job with WPIX-TV (Channel 11) as an engineer. I started out as a sound engineer, but quickly worked into technical directing, and then to chief cameraman. My next stop was with KBTV in Dallas as a producer-director, and then WXEL in Cleveland directing their network show originations.

So, how about you? Are you just another goldbrick in a lead-balloon career path? Or are you using your job as a way to learn and grow? Are you a royal pain in the ass to your boss with your ideas for improving things?

When I was working in radio I didn't have to sell ads or write shows, I could have done like everyone else around me and done a minimum to get along. Ditto when I was working in TV.

It's exciting to learn new things, yet somewhere around 99+% of the people I've worked with and for have avoided this. If a

person were to read one book a week from my guide to "books you're crazy if you don't read," within a couple of years they'd be very well educated. Two a week, which is a snap once you get the hang of reading, and it would only take a year.

Under our guidance and example, our kids are hanging around malls, cruising, and watching an average of 50 hours of TV a week instead of reading and learning. They're just following in your footsteps. Or, more likely, seat cushions.

You have the opportunity to use your job as a way to learn many things. And amateur radio provides a wealth of learning opportunities. I was one of the first with NBFM, sideband, slow scan, repeaters, and so on. I've worked a ton of DX, won most of the contests, and DXpeditioned from a bunch of rare spots. You can put all that down to Wayne's ego, or maybe look on it as an example of what anyone can do with the opportunities that amateur radio provides. I've used every job and every interest I've had as learning opportunities.

There's a fantastic world of things to learn and do out there if you'll get off your duff.

Science, Hard and Soft

An amusingly high percentage of what I was taught in school as science fact has turned out to be science fiction. Well, science theory, since discredited. Quantum mechanics, as I've mentioned, wasn't even mentioned in college. The sad part is that even our scientists haven't been able to learn from experience. They're still, for the most part, firmly intellectually anchored to what they were taught as fact in college, and most of them vigorously resist new theories.

For instance, our physicists have been constructing ever-larger atom smashers in an effort to find out what atoms are made of. For some reason the Holy Grail is imagined to always be just a tiny bit out of reach. But, as I've suggested, perhaps the Universe isn't as simple as it looks. Perhaps matter is made up of elements, which are made up of atoms, and atoms are made up of quarks, and quarks are made up of what? Sub-quarks, of course. So what are sub-quarks made of? Let's build a really BIG atom smasher so we can blow the quarks to smithereens and see what the smithereens look like.

I've suggested that this may be a lot like scientists trying to find out what basic elements go to make up a house. So they blow it up and say, aha! The basic elements are wood, bricks, wire, pipe, and so on. Case closed. Well, maybe there are sub-smithereens. And even sub-sub-smithereens.

What I'm suggesting is that a bunch of what we consider hard science isn't all that hard.

And then we come to what I call soft science. Here we're way out in left field with things like auras, reincarnation, dowsing, the fundamentals of life, consciousness, crop circles, alien visitors, UFOs, magnetism, past lives, ghosts, psychics, time travel, heaven, all religions, God, spoon bending, clairvoyance, psychokinesis, ESP, the cause of diseases, immunization, the value of fluorides in our public water supply, NDEs, OBEs, demonic possession — and what have I missed?

How real is dowsing? It's as real as your information on the subject. If you have done no research and read no books, you can shrug it off and ridicule those who have done their homework. In my book guide I recommend Owen Lehto's *Vibrations*. Read it, try it, and see what kind of a skeptic you are about dowsing then.

Along the same line you really should read Margaret Chaney's *Red World, Green World*. She's W8ONS, by the way. She uses a dowsing technique to find out which foods are good for you, and which are bad. And eating food that's bad for your body type sure ain't good.

How real are past lives? It depends on how many well researched books you've read. I've found that under a hypnosis I'm able to regress almost anyone to a series of their past lives, complete with an amazing amount of detail. Further, I've often found that traumatic past deaths can heavily influence people's current lives.

Unless you read a book about Royal Rife and his incredible microscope you may not know what he discovered about the most basic element of life. He was able to watch live cells under his 17,000-power microscope and found what he called protids, which were almost indestructible. The book about Gaston Naessens and his microscope tells about his discovering the same thing, which he called somatids. And Pierre Béchamp, 150 years ago, discovered them and called them microzymas. The FDA destroyed all of Rife's microscopes and put him in prison. Their Canadian counterpart tried to do the same to Naessens. It's a fascinating story.

It seems that just about every soft science I look into turns out to have been carefully researched and looks real.

But then I've always enjoyed anomalies, seeing them as clues to things that should be investigated, not ignored. Yes, I know, it's *all* swamp gas. Do I have some sort of genetic disorder that makes me curious? I notice that most people are not only not curious, they will go to remarkable lengths to avoid thinking. Well, I suppose that's why we have bars and other such entertainment to kill the time that might otherwise be spent reading and learning.

Yes, I been there, done that with bars too. That was when I was in the Navy and went into San Francisco every night to the Irisher bar with my shipmates while our boat was being refitted at the nearby Mare Island shipyards. We had a lot of fun and I sure managed to get really drunk a few times.

Anyway, the next time you think Uncle Wayne has been conned on some sort of soft science, you let me know and I'll cite some darned good references to back up my opinions. Since even the solidest of science seems to be ever-changing, I haven't formed much in the way of entrenched beliefs, but I have a bunch of well-formed opinions and a load of questions.

Timing ...

... they say, is everything. An article in *Fortune* (8/4/97) on the record industry disaster, where most of the large record store chains (Wherehouse, Strawberries, etc.) have gone bankrupt, taking with them thousands of mom-and-pop independent record stores, didn't come as a big surprise to me. I got into the music business at just the right time, just before its meteoric rise in the mid-'80s, and got out of it at the right time (1992), just before it crashed and burned. And I told you in my editorials about the opportunities for taking advantage of this high-growth field at the time.

Those of you who have been reading *73* for over 20 years know that I predicted the personal computer's astounding growth. And I took advantage of it. I also recognized when the industry had matured and got out at just the right time (1983).

It's a whole lot easier to grow a high-growth industry company by getting in early, so if making a lot of money is a priority for you, why not take the easiest path? I don't get involved with the goal of making money — I get my kicks from helping new industries get started.

In a mature industry you have to fight the vested interests, and they have everything going for them, so it's a long, hard fight. In a new industry there is so much growth that "a rising tide lifts all ships."

In the personal computer field Bill Gates was there first with BASIC software for the Altair 8800 and Steve Jobs was there with the first single-board computer. So, where were you? I suspect you were busy working for someone else instead of starting your own company, commuting to the daily grind. Hey, I've been-there-done-that, so I know what it's like. The longest I ever worked for someone else was when I was the editor of *CQ*, which lasted for five years. I was having so much fun that if they hadn't fired me, I'd probably still be there.

I started in 1955, leaving a very successful loudspeaker manufacturing company I'd built from scratch. *CQ* was in terrible financial shape, losing a ton of money. Six months later I had it in the black and got it to where it was making millions. I did what you'd probably do: I bought a yacht, an airplane, an Arabian horse and *two* Porsches. And I traveled, going on scuba diving trips to the Bahamas, Mexico, and the Virgin Islands. Then there was a DXpedition to Navassa (KC4AF), where we darned near got killed a couple of times. And, by 1959 I was in Geneva as an official US representative at the ITU Plenipotentiary Conference. Later that year Bill Leonard W2SKE and I flew around the world, operating a sideband ham station from the plane, and visiting hams in 22 countries.

Luckily I got fired in 1960 and that forced me to start my own magazine. I sold my horse, boat, plane, and newest Porsche, getting just enough money to print the first

issue of *73*. The magazine took off and even managed to survive the almost total destruction of the ham industry in 1964–65. Well, I've written enough about how the ARRL caused that disaster, one from which the American ham industry has never recovered.

In 1969 I saw 2 m FM and repeaters as a possible way to get amateur radio growing again. I organized repeater conferences around the country and published hundreds of articles, a bunch of books and a special magazine on the subject. Soon 2 m became the biggest growth aspect of amateur radio. Here we are 28 years later and 2 m is still our most active ham band, by a wide margin.

It was my success with repeaters and 2 m that got me to thinking I could do it again when the first personal computer kit was put on the market in January 1975. In my *73* editorials I told you what I saw ahead. I got big snickers when I predicted that the computer industry would one day rival the auto industry. Today computers are the third largest industry in the world.

Since I didn't know anything about computers I started searching for an editor for a magazine to help this new field grow. By May I'd found one and work started on *Byte*. The *73* staff did most of the work and the first issue of *Byte* went to the printer in July, just six weeks after we started on it. In that short time I rounded up a few thousand subscribers, the needed advertisers, organized national newsstand sales, and got the ham stores to carry the magazine. It was a busy six weeks.

I did my best to get the *73* readers to take advantage of this new industry. A few did and did very well. But most readers never budged. By 1983 I could see that the industry had matured, that the days of 235% a year growth were past. So I sold all my computer magazines and my software company to IDG, the publisher of *Computerworld*. Alas, none of the magazines kept up with industry changes and all eventually blew away.

In 1982, when the first compact discs were announced, I saw a new growth industry ahead as the world converted from LPs to CDs. That meant that everybody would have to start over and build new record collections. So I started *CD Review* in 1983 and rode the rising tide. The magazine soon became the leading American music magazine and helped sell billions of dollars of CDs.

By 1992 I could see that the major growth period was over. LPs were long gone and by then record collections had been rebuilt with CDs. Worse, there was no outstanding new music being written. No hit Broadway or movie musicals. Even the classical music field had dried up, with nothing new I could find worthy of one listen, much less buying. So I sold the magazine to IDG, where it quickly sank out of sight as the industry collapsed.

So what's the next big growth industry going to be? Hey, I've been telling you about that for the last three years. It's going to be cold fusion, as low energy (and nonpolluting) nuclear power replaces the oil companies, gas stations, coal, the power companies and their transmission lines, and so on. We're talking trillions this time. I predict that within 20 years this is going to be the largest industry in the world, with a bunch of new billionaires. You have the choice of watching it grow or being a part of the action. The ground floor still has plenty of open areas.

Will the oil companies be as blind to this new technology as the mainframe manufacturers were when minicomputers came along at 10% of the cost and ate their lunch? And then, not having learned, the minicomputer companies ignored personal computers, which blew them away, again at 10% of the cost, but with comparable performance. That's what history tells us will probably happen.

This is a whole new industry. No more oil drilling. No tankers (and spills). No pipe lines (and spills). No refineries (and pollution). No gas stations uglying street corners and stinking up the neighborhood. No local oil companies. No home oil burners. No coal-fired generating of electricity. No electric meter in your home. No natural gas for our stoves, not when cold fusion can supply energy at 10% of the cost of using fossil fuels.

The *73* readers laughed at me when I predicted that they would be seeing TV commercials for computers. In a few years we'll be seeing ads for home heaters, home and business power generators, and so on. A huge new manufacturing industry will grow, along with sales and service. And that's the way you turn bucks into megabucks — and then gigabucks. Electric cars? Har-de-har! Well, perhaps, but with cold fusion power plants generating the electricity. Or perhaps we'll see the rediscovery of the steam car.

I have a tape of me describing today's laptop computers at my talk at the 1976 Atlanta HamFestival. If you kvetch until your hamfest chairman gets me on the program, I'll tell you more about what I see as the opportunities for new industries you can grow with. All I cost is travel expenses for Sherry and me.

Getting back to the music industry, I'm kinda glad to see the record store chains getting their comeuppance. The whole industry is so crooked that it is pathetic, and it has been protected by our easily bribable Congress. When I got involved I found that six record giants controlled 96% of all record sales. Five were foreign-owned. Worse, as an article in *Forbes* pointed out, only about 2% of the performers on these labels ever were paid any royalties. I found that there were several thousand small independent record companies making up the 4% of sales. I thought that situation stunk, so I started a journal to help the indies organize, and put out sampler CDs with the best track from each of their new CD releases. I put out about 125 of these samplers, each with about 15 tracks, and distributed millions of them. Even though the majors were spending about $100 million a year to make sure that only their music got played on the bigger radio stations, between the reviews I published of indie music in *CD Review*, the samplers, and my pushing independent record stores to sell indie music through *Music Retailing*, which I also published, the sales of indie music went up to 14%, a gain of over a billion dollars a year in CD sales.

To give you an idea of how thoroughly the record business collapsed, when I sold *CD Review*, I had an option to use six pages a month to advertise my CDs. In 1992 these ads were bringing in around 10,000 orders a month. By 1996 the same ads were pulling about 50 orders a month.

Well, when I found that the indies were getting screwed by the majors I saw an opportunity to do some good. And I did well — plus I had a lot of fun doing it. Did I tell you about the time I had an opportunity to conduct an orchestra? Wow, was that ever fun!

Keep your eyes open for opportunities. New technologies are a wonderful way to get started without a lot of investment. When home security products started coming on the market I advised my readers to get into the business. A few did and did very well. I heard from a ham recently who said it was my editorial that got him moving. He's made millions in the security business as a result.

Instead of me telling you all the time, how about you keeping an eye on *Popular Science*, the business magazines and newspapers and telling me what new industries you see that might be developed.

For instance, our 2 m repeaters were so much fun that I knew right away this would be a technology that the general public would go for. Back in 1969 I had my HT with me wherever I went, talking with local hams while skiing in Aspen or on our NH mountains. I remember the old Gronk Network, which allowed me to stand on a street in Las Vegas with my HT and talk in a roundtable with hams in San Francisco, Phoenix, and San Diego. Now I'm seeing people in almost every country in the world making phone calls on the streets and from their cars with the modern counterpart of our old HTs.

Kick-start your imagination.

Viva Dilbert!

I enjoyed Scott Adams' *The Dilbert Principle* so much that I quickly bought his next book, *The Dilbert Future, Thriving on Stupidity in the 21st Century*. It was well worth the $25, though I probably should have waited for the paperback edition to save a few bucks.

There's nothing like a hilarious book to ease the day's stresses when I finally hit the sack at night, and Dilbert really delivers.

But much to my surprise Adams snuck in some thinking material at the end of the book. First, he got physical, delving into some of the weirder aspects of quantum physics. And then he got metaphysical, but with a message that will benefit anyone who reads it and applies his principle. What he says is that if you envision some desired goal and really want it to happen, events will, in some serendipitous way, make it happen.

Well, this ties in with some thoughts I've had (and, of course, written about) having to do with the influence of consciousness (for the lack of a better term) on lifeform mutations. I suspect that Darwin was partly right with his "survival of the fittest" concept, but that consciousness in some way also acts as a powerful force when it comes to guiding evolution.

Scientists get deep into speculation (and solidified beliefs) when it comes to how life started. The timetable astronomer Fred Hoyle proposed, which makes a lot of sense, requires a Universe that's a lot older than the Big Bang theory poses. But then, Eric Lerner shoots a lot of big holes in the Big Bang theory in his book. You really should have read both of these chaps' books by now. I've reviewed these books in my editorials and included them in my guide. What more can I do to get you off that couch and educating yourself? It'll sure help make you a lot more interesting to talk with on the air. Your education shouldn't stop when you leave school. The fact is that around 99% of the stuff they made you memorize to pass those useless tests is long gone from your memory by now, but even if you had 100% retention, little of it would be relevant to your present life.

All life has some degree of consciousness, even trees. Oh, you haven't read *The Secret Life of Plants* yet? Forsooth! Hie thee to Barnes and enNoble your mind. We know very little about consciousness. If you've read Stone's book on our cells you know they're somehow in contact with us, no matter where they or we are. And this probably has something to do with my mother sensing one of the most stressful moments of my life and calling me at the moment from 120 miles away to ask what was wrong.

Now, getting back to Scott Adams, he recommends that you decide on something practical that you really want. Write down this wish on paper. Make it very specific. And then watch as it somehow comes about. Oh, heck, read his book. You'll get a barrel of laughs, plus some valuable philosophy.

HIV Update

Tom Miller WA8YKN has been hearing from a Bioelectrifier user whose viral count has been going down by 50% every time he's been tested. It's now gotten below the threshold of the test, so the guy is ecstatic. That's a nice reprieve from an AIDS death sentence.

Tom also heard from a chap who'd been told that a secret government agency was about to unleash a deadly mutation of the bubonic plague in order to kill off 75% of the population. The only protection from this would be the use of silver colloid, which the same source had available at a very high price.

Tom explained that with the government some $15 trillion in debt (two-thirds of it off the books), the last thing the government would want to do is kill off taxpayers. They're

Continued on page 81

Number 78 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
E-mail: [dmiller14@juno.com]

From J. Frank Brumbaugh W4LJD: Here's a tip that parallels his article on gel cell batteries, in the February 1997 issue of *73*.

"Here's a very simple way to keep tabs on your gel cell battery when it's powering a QRP rig, emergency setup, Field Day station, etc. It's an inexpensive expanded-scale charge-status-meter that can be left connected across the gel cell during the entire time of operation, since it draws only microamps from the battery that it's monitoring. **Fig. 1** shows the easy-to-reproduce circuit in schematic form. The actual part values will depend upon what your own junk box yields, what might be obtainable at the next hamfest, or which surplus outlet you might tap for the least amount of cash outlay on your part. M1 in the schematic is a surplus microammeter, which may be 50 µA, 100 µA or 200 µA full scale—whatever you can find. The smaller the full-scale reading of the meter, the less current will be drawn from the battery you wish to monitor for a given mid-scale reading. D1 can be any garden-variety silicon diode (such as a 1N4001). Its main purpose is to prevent any possible damage if you happen to inadvertently reverse the plus and minus input leads. ZD1 is a 1N4739, 9.1 V, 1 W zener diode. Any combination of lower-voltage zeners in series that adds up to about 9.1 volts will also work. Due to the extremely low current drain, the wattage rating of the zener diode is not particularly important. R1 is an inexpensive 'set and forget' trimpot, whose value will be dependent upon the actual sensitivity of the final meter that you might end up with. For a 50 µA meter, R1 can be a 100k ohm trimpot. Just wire everything in series, with the polarities shown as shown in the schematic, and you're all set.

"As mentioned before, this is an extremely low-drain, expanded-scale voltmeter circuit. Anything over about 9-1/2 V will give you a reading, and you can place the meter's needle wherever you'd like it to be on the meter's scale, by using the trimpot. You can mark the meter's scale with actual voltage figures, or simply with an 'OK range' and a 'STOP range'.

"If you intend to treat your 12-volt gel cells with the care and respect that they deserve, 11.5 volts is generally the point at which you'll want to stop discharging them, and this simple metering circuit will tell you when to do it."

Moderator's note: Nice idea for a handy battery monitoring circuit, Frank. By the way, you can modify the circuit to accommodate any battery voltage that you'd like to monitor (6 V, 9 V, etc.), just by altering the choice of zener diode (ZD1) in Frank's schematic. Choose a zener diode (or combination) whose zener-voltage rating is a volt or two below the stop-discharge-potential of the battery pack that you're using. Everything else should stay pretty much the same.

More power to you

From Stephen Reynolds NØPOU: "I've always wanted a dedicated power feed into my ham shack, but my power service panel wouldn't support the needed breakers and capacity. It would have been possible to have a new power service entrance panel professionally installed, of course, but that was beyond what I wanted to allocate from my already limited ham budget.

"A previously unseen opportunity presented itself, however, when our electric stove finally gave up and we decided to replace it with a gas unit instead. I now had a 240 V, 40 A circuit on my current fuse panel that was available for other usage, namely my ham station! I ran #8-gauge wires to a new sub-panel in my shack, being careful to follow all of the electrical codes for my area, and I now have plenty of power conveniently available for just about anything imaginable, of either a 240 V or 120 V nature.

"If your own fuse service panel is currently filled to capacity, and you have an electric stove, electric clothes dryer, or electric water heater, you might be able to utilize any of those circuits for your ham shack simply by replacing that older electric appliance with a new gas-fired model—without the extra expense of a whole new entrance panel. Be familiar with and always follow your own local electrical codes to the letter, if you decide to implement this idea yourself. And seek out the help of a licensed electrician if you don't have the experience or inclination to do it yourself. Now where did I see the ad for that super-duper linear amp?"

Moderator's note: As Stephen mentioned, don't involve yourself with your home's 240 VAC service unless you're absolutely confident that you know all of the proper procedures for dealing with that level of electrical power. 240 VAC is deadly!

Plug potpourri

From David Hyman KBØONF: "If the AC power cords in your ham shack, computer station or test bench seem to be a jumble of unidentifiable cords and plugs, you're not alone. Here's an idea that you might try, to at least put some measure of order back into that maze of plugs.

Continued from page 63

take place, the other transmissions from that station are still copied to my monitor. It isn't simply a weak signal or some other receive problem.

My conclusion after all this is that the BayCom software does the job. It is the secret of running the bare-bones BayPac modem. I am sure that eventually the local PBBS will get tweaked, so it will make the connection easier. It appears that the Hamcomm software will do the job once I find another ham who has had the same experience. Those things take a little time and this is, after all, a hobby.

I don't think I would suggest this combination to someone as their first venture into digital hamming. It is much easier to use one of the bigger magic boxes and the simpler software that isn't so "trick." I am quite impressed with all the products and am sure they work for those who have labored so many hours to perfect them. And they will for any of us who persist.

One of the things that makes it difficult to use the multimode software is the fact that the once crowded AMTOR and RTTY spectrum is now fairly dominated by PACTOR. There are not many remaining hams to contact with those modes. There is an upgrade of the Hamcomm software that copies PACTOR. This should mean that there will be full-fledged communication available by that mode with the BP-2M one day in the future.

As for CW, it is fascinating to watch a computer copy the code. CW is one of my all-time favorites. When I was first licensed in 1949, that was all my money and other circumstances would permit me to use. And as all of us from that era will attest, it is still the most dependable low-power medium under adverse conditions. Under such conditions it would be difficult to expect a computer to pull code out of surrounding noise and make it readable. The error-correction capabilities of the new modes would be able to get through up to a point.

At this time, I am satisfied to have a portable packet station up and running. The cable and the shirt-pocket-sized modem altogether weigh about two ounces. That is a barely noticeable addition to what I usually carry with me when I travel.

If you have questions or comments, E-mail me at the address at top or at CompuServe [72130,1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line at [KB7N@ N7NPB.#NONEV.NV .USA.NOAM]. 73

"Stick a small square of white vinyl tape on each plug, and mark the tape with an easily-read identifier, such as the type number of the item of equipment that it powers. Make sure that when the plug is inserted into its socket, the tape will be in a position that's readable ... since most plugs are polarized these days and they can only be inserted one way. Also be sure to use vinyl tape, because it tends to be more compatible with the rubber or plastic surface of the typical AC plug than other varieties. Vinyl tape is generally available at automotive supply stores because it's been shown to hold up against the rigors of an automotive environment better than others, and it will do the same behind your operating table or test bench."

Moderator's note: If there isn't enough room on the tape for a full identifier, you can simply use a single number. Make the number large enough to read and clear enough so there's no mistaking what it says. Now make up a list on a card or sheet of paper that identifies each number with the item of equipment that it represents. Keep that card somewhere handy so you'll have it when you need to ferret out a particular plug for removal. A good idea from KBØONF.

Tight fit

From William Thim N1QVQ: "Mobile antennas that screw into their mounting bases often have a tendency to loosen up over time. If your antenna's manufacturer hasn't supplied some type of lockwasher for use between the antenna radiator and the mobile mount, then you might consider backtracking and installing your own. The 'wavy' washer shown in **Fig. 2** works nicely, applying pressure between the radiating element and the mount itself at several points around its perimeter. You should be able to locate these washers at your local hardware store or home center. One (or even two) will usually guarantee that your mobile antenna will stay good and tight in its mounting, if the antenna is snugged down correctly to start with. In place of the wavy washer, you might be able to use one of the older split-ring types of lockwashers, though the split-ring types only provide one primary point of pressure per mating surface (top and bottom). Whichever lockwasher system you choose, make sure that the metal that it's made of is compatible with the metal used in your particular mobile antenna and mount. Electrolytic action between dissimilar metals can often defeat any gain made by keeping the mounting tight, especially in areas of high humidity and/or salt air, such as might be encountered along coastal areas. Also recheck your SWR after adding any lockwashers to a VHF or UHF antenna to make sure that it hasn't changed appreciably, trimming the radiator's length slightly if necessary."

Moderator's note: I've experienced the antenna loosening that Bill mentions on my own mobile installation. I have the feeling that it's probably due to a combination of road vibration and wind against the antenna, along with the continual changes in temperature that our mobile antennas are subjected to. The result, of course, is that, over the course of time, the antenna radiator can make poorer and poorer contact with its screw-on mounting stud, leading to intermittent and unpredictable signals on both receive and transmit. In the worst of cases, the transceiver's finals could even be damaged by the quickly varying loads reflected back into the radio. Bill's solution is a good one, along with routinely checking the tightness of the antenna in its mount as a regular maintenance item. A coat or two of your vehicle's touch-up paint around the mobile mount/lockwasher/antenna joint will also help to protect against weathering and electrolytic action, as well as serve as a visual indication of loosening if the paint shows any significant fracture lines.

Murphy's Corollary: Feeling completely satisfied is generally a temporary aberration.

That's it for this month and the first column of our third year on the pages of *73*. Many thanks to all of those who've made contributions to the column in the past two years, and as always, to those who've sparked the ideas featured in this month's edition, including:

J. Frank Brumbaugh W4LJD
P.O. Box 30
c/o Defendini
Salinas PR 00751

Stephen Reynolds NØPOU
510 S. 130 Street
Omaha NE 68154

David Hyman KBØONF
1455 Edgcumbe Road
St. Paul MN 55116

William Thim, Jr. N1QVQ
50 Miller Road
Broad Brook CT 06016-9676

Also, be sure to check out the Ham To Ham column's home page on the World Wide Web at: [http://www.rrsta.com/hth].

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73 and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or 73 for any equipment damage or malfunction resulting from information supplied in this column.

Please send any ideas you would like to see included in this column to the moderator at the address at top. We will make every attempt to respond to all legitimate ideas in a timely manner, but please send any specific questions, on any particular tip, to the originator of the idea, not to this column's moderator nor to *73*.

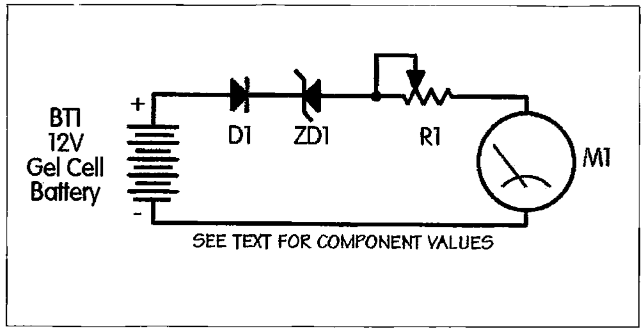


Fig. 1. W4LJD's gel cell battery voltage monitor. See text for additional details as well as for all component values.

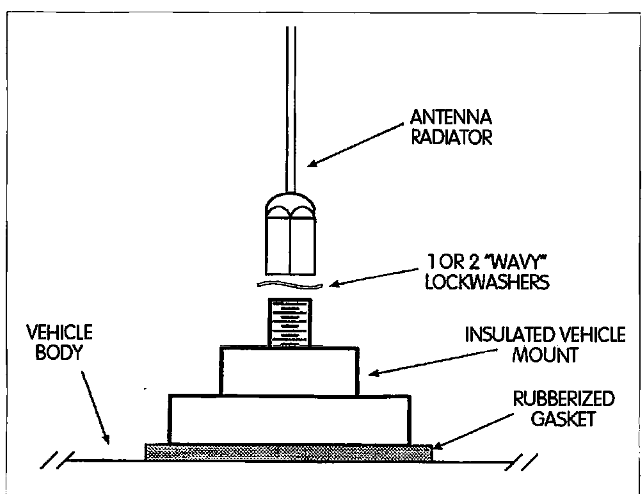


Fig. 2. N1QVQ's suggestion of using a "wavy" lockwasher to ensure a snug fit between a mobile vertical antenna and its vehicle mount.

QRP

Number 80 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
955 Manchester Ave. SW
North Lawrence OH 44666

If you're like me, you spend a lot of time tinkering with new projects. But don't you just hate building and rebuilding the same basic building block circuits over and over? I sure do. I know of no one who enjoys reinventing the wheel.

Normally, I use one or two basic circuits to power my latest creation. It takes time to build and rebuild these building blocks, so I've decided to assemble several of my favorite circuits on one PC board. It then becomes a simple matter to simply plug into the building block and start having fun.

Perhaps if there is enough interest, I'll design more modules. That way, you can put more effort into fine-tuning a design instead of reworking old circuits.

The power control module

This module provides several different operating voltages. It also supplies a highly stable reference voltage. The power control module will also generate a negative reference voltage, very useful if you're dealing with microprocessor and/or ADC chip sets.

Fig. 1 is the schematic for the power control module. If you look closely, you'll see four distinct subcircuits. These are the main voltage regulator, the +5 volt regulator, the reference diode and its buffer, and, finally, the charge pump generator.

The main voltage regulator is a very simple circuit. In fact, I lay no claim to it. This circuit has been around for a long, *long* time. What makes it so slick is its ability to accept a very high input voltage. I needed this requirement, as I have been working on an FET amplifier running from a 28-volt supply.

There are several items of interest in this circuit. Notice the two 47 µF caps in series at the input. By using the caps like this I was able to raise the working voltage, but without spending money on 50-volt units.

There are two inputs to the main regulator. One is labeled "+BATT," and the other, "AUX." A 1N4002 diode in each leg steers either source into the regulator, but without connecting the sources together. On the other hand, if you require more than the one amp of current from the main regulator, you can connect the AUX and +BATT leads together. This effectively puts both diodes in parallel.

The voltage is set by zener diode D4. Change D4 to increase the output voltage. With the values shown, the output is 12.0 volts with very good regulation. I've pulled 500 mA out of the main regulator with no trouble. A heat sink is required on the pass transistor, Q1.

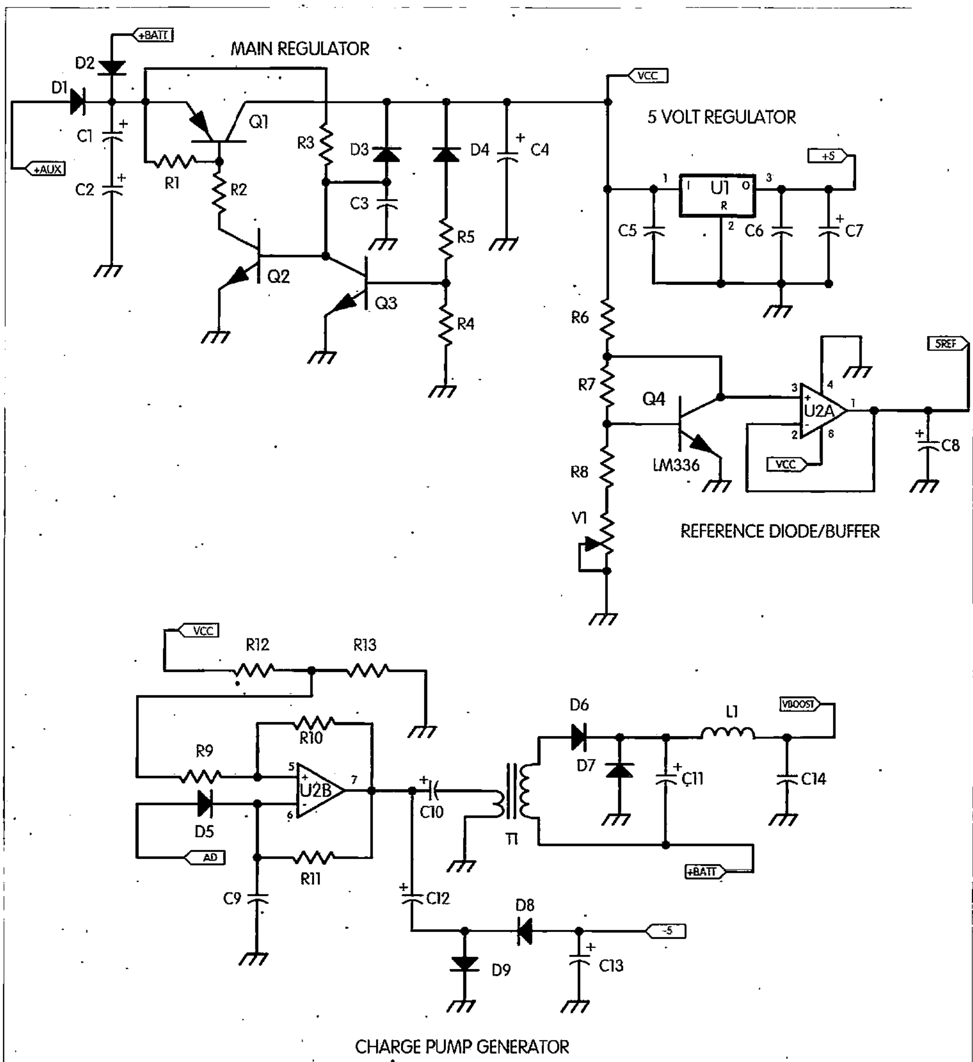


Fig. 1. Schematic for the power control module.

The +5-volt regulator

Since more and more microprocessors are finding their way into our transceivers, I decided I just had to have a five-volt supply. In this case, I decided to go cheap and simple. A 7805 one-amp regulator is pressed into service. Once again, the circuit is very simple. Capacitors on the input and output leads keep the regulator stable. If you have to have more than 150 mA from this regulator, a heat sink will be required.

Remember, the total current flowing from the +5-volt regulator must also pass through the main regulator. The limit on the +BATT diode is one amp, unless you connect the AUX line to the +BATT line as I mentioned.

The reference diode and buffer

I work with op amps and voltage comparators a lot. So, I required a very stable voltage reference voltage. I also wanted to be able to move this reference around a tad.

To accomplish this task, an LM336ZA-5.0 precision diode is used. To vary the output of the diode, a voltage divider consisting of R6, R7, R8, and trimmer V1 is used. With this arrangement, you can set the diode's

output from 5.00 to 4.12 volts. The output of the diode is fed into one section of an LM358 op amp. This section buffers the diode's output and allows one to draw up to 20 mA of current.

The charge pump

Since I do a lot of work with power MOSFETs as high-side switches, I needed a voltage source at least ten volts higher than the supply. The charge pump takes the output from a free-running oscillator and dumps its energy into a transformer. This energy, combined with the +BATT voltage, is available at the VBOOST output. With +BATT at 14 volts, the VBOOST voltage can exceed 50 volts with a 12-volt input!

Take a closer look at the oscillator, which used the other half of our LM358 op amp. The label AD is used to turn off the oscillator. By applying a positive signal to this input, the oscillator stops. When the oscillator is not running, VBOOST will drop to +BATT. Or from about 50 volts down to 14 volts.

Take one more look at the output of the transformer. If you remove the +BATT lead from D2, and run the main regulator from the AUX input, you also can stop the charge pump. So, in effect, you have two ways to control the output of the charge pump.

On the output of the oscillator, there is a simple voltage doubler. This doubler produces the -5 volts. Unloaded, the voltage hovers around -10 volts. As with the charge pump, applying + volts at the AD input will turn off the -5 volt output.

Nothing set in stone

With the exception of the voltage divider used for the reference voltage, there are really no "don't touch" components. Feel free to change values to suit your junk box or your requirements.

Building the power control module

I designed the module to be assembled on a PC board. A Circad file has been uploaded into the HAMNET library in the "QRP" section. File is called powermd.zip. The PC board is correct and several have been built.

The power module PC board is double-sided, with plated-through holes. If there is enough interest, a very short run of PC boards may be made. There is no reason why you can't hard-wire a module if you want to.

The PC board input and output lines are on 0.156-inch centers. This allows me to use a single module for several projects. The plug is hard-wired to the project under construction. This plug goes into the power module. I can change designs or start another project by simply "plugging in" to the power module.

The main pass transistor and the 7805 each require a heat sink. I found one from Hosfelt™ for less than a quarter. The PC board was designed around this heat sink.

Though it's not shown in the schematic, I put in four LEDs to monitor the main output voltages and the two input voltage sources. A DIP jumper allows you to turn off the LEDs if you desire. I find these very useful. It sure speeds up troubleshooting a VXO when it helps you discover that you have yet to put the juice to the module. Not that I've ever done anything like that, mind you.

Changes

You can change the 7805 to a 7806, -08 or -09 regulator. You can't use a 7812. There's not enough overhead from the main regulator to allow a 7812 regulator to operate.

Any of the popular dual op amps available will work for U2. You might try one of the low-noise ones on the market.

If you need a negative voltage other than the -5, add a zener diode of up to 10 volts at the output of C13 and D8. Since there is little current available, the zener will clamp the voltage to its rating.

I found the power module to be very handy. I hope you do, too. I plan on at least two more modules. One will be a power audio amplifier with AGC and the second a BFO/IF amplifier.

QRP ARCI membership

Unfortunately, I'm no longer able to be the membership person for the QRP ARCI. Overworked and underpaid. Please *do not* send your renewals to me. Right now, send them to Ken Evans, 848 Valbrook Court, Lilburn GA 30047.

Parts List

C1, C2, C4	47 µF 25 V
C3, C9	.01 µF
C5, C6	.1 µF
C7	100 µF 16 V
C8, C12, C13	47 µF 16 V
C10	22 µF 16 V
C11	47 µF 50 V
C14	.47 µF
D1, D2, D7	1N4002
D3, D5, D6, D8, D9	1N914
D4	1N753A
Q1	TIP42A
Q2	MPSA06
Q3	2N4401
Q4	LM336Z-5.0
R1, R9, R10	100 kΩ 1/4 W
R2	2.7 kΩ 1/4 W
R3, R12	10 kΩ 1/4 W
R4	510 Ω 1/4 W
R5, R7, R13	4.7 kΩ 1/4 W
R6	2.2 kΩ 1/4 W
R8	16.9 kΩ 1/4 W
R11	47 kΩ 1/4 W
L1	1 µH choke
T1	Mouser™ 10 k to 1 k driver transformer
U1	7805
U2a	LM358a
U2b	LM358b
V1	5 kΩ trimmer

***Table 1.** Parts List for the power control module.*

NEVER SAY DIE

Continued from page 77

not dumb enough to kill the golden goose.

Getting back to the Bioelectrifier, if you've built or bought one, please let me know of any successes with it, okay? Or failures. I've had quite a few letters on successes, but none on failures yet.

Good-O

Thanks KC4RIB for copies of the six Field Day notices which appeared in the Atlanta area newspapers inviting visitors to watch the North Fulton Amateur Radio League at work. How much PR did *your* club get out of Field Day? Or did you keep the whole exercise a secret from the public? Tsk.

Quick QSKer

Build a "full break-in" controller for your rig/amp.

Laurence C. "Curt" Raynes KD7FY
2150 Laura Street #85
Springfield OR 97477

Many of us who like to operate with QSK have set aside old amplifiers because they couldn't function that way. Here is an inexpensive way to put that old friend back to work. This started as a CW project, but the speeded-up amplifier reaction time works fine with SSB and Amtor, and its low-current DC input will no doubt work safely with your transceiver.

The circuit

Fig. 1 shows how. Relays Ry1 and Ry2 switch the amplifier input and output. These relays are small, inexpensive, and—as AC split-core relays used with DC—very fast. There is good current capability, as they have 10-amp contacts and are DPDT. They have adequate insulation to work directly at the 100-watt RF level, and they can switch a kilowatt if their coil leads are isolated with RF chokes. They have small current requirements, so the voltage drop across the RF chokes is not significant. I have never had one of these relays arc down, but I do take off the plastic cover and dress the coil leads away from the metal frame.

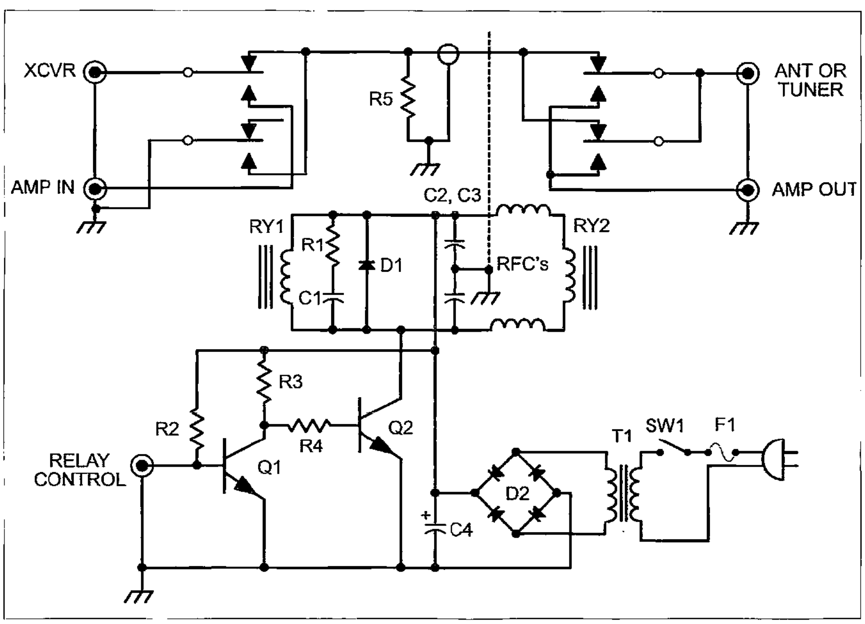


Fig. 1. Schematic.

The transistor control amplifier is the simplest. With key-up, Q1 is conducting maximum current which is limited by R3 to about 3.5 mA. Its collector voltage is much less than a volt; this holds Q2 cut off, and the relays in the receive position. With key-down, Q1 is cut off and Q2 is saturated. This puts the full supply voltage of about 125 VDC across the relay coils, which really snaps them closed, each getting about 30 mA of current. The transistors do run cool because when conducting current, their collector voltages are very low. Feel free to substitute parts, as none of the values are critical.

The relays are cold-switched. My transceiver has 14 milliseconds from keydown to RF output, and the relays close easily inside this time. A check

with my scope showed that the relay bounce time was very short, and over long before the RF gets there.

My transceiver continues its RF cycle for eight milliseconds after key-up. The relays are held closed through this end of the transmit cycle by capacitor C1. On-the-air checks with people I know to be good technicians have confirmed there are no key clicks on the QSKer system when it is used with a modern transceiver. To my knowledge, the QSKer has worked well with an ICOM 751A, an ICOM 761, a Kenwood 140, and a Ten-Tec Omni D.

Relay chatter can be minimized by mounting the relays inside soft foam plastic holders. Make a block of foam sized to a secure fit inside a box or under the chassis of the amplifier. Carve a hole in it to make a snug fit for the relay and socket with the terminals sticking out. Make short interconnects of small braided or twisted wire in an S configuration to minimize sound vibrations telegraphing to the chassis, as it will act as a sounding board. If needed, the foam can be cemented to a metal surface, but do check your adhesive. Some will melt foam plastic.

Parts

Parts are mostly available from neighborhood electronics hobby stores. 2.5 mH, segmented RF chokes are not as common as they used to be, but there are still a few around. You can test them for this application by putting them across a 500 W, 50 Ω load at the frequencies on which you intend to operate. If they stay cool or mildly warm, they're OK. 300 V transistors can be found at an electronics supply house. One-to-one small power transformers are not common now, but two identical low-voltage transformers back-to-back work fine.

Currently, with my Heath HL2200 amp, I'm using its +120V hold-off voltage to run the QSKer, which is built inside it and replaces the original antenna relay. I have a friend who didn't want to modify his old but beautiful Henry amplifier. We built his QSKer in a box, self-contained, and he sets it on his receiver and runs interconnecting coax. Either way, they work great.

These relays have good longevity. I used them for several years before I had the first sticky relay. Not bad for a seven-buck item. Costwise, the QSKer can be built for about 60 bucks—or less, if you have a good junk box. Compare that to the cost of just one vacuum relay.

Performance

This circuit has been used some at the kilowatt level with no apparent problems. There have been a number of these built, and all that I have known about have worked well. At 20 wpm, I hear between the dots. Faster, I catch a BK but I don't hear much between the dots. With my ICOM, the RCA jack labeled "relay" on its back side supplies switching information for the QSKer to run CW, SSB, or Amtor. If this isn't available with your transceiver, parallel the CW key contacts with the QSKer input.

Remember, there is *lethal* high voltage inside the cabinet of your amplifier, and Murphy lurks everywhere. If you're not experienced with high voltage, it's best to build this project in the company of a friend who is. 73

Item	Description	Radio Shack #
Ry 1, Ry 2	125 VAC, DPDT, 10 A	275-217
Relay socket		275-220
C1	0.1 μF, 200 VDC	272-1053
C2, C3	0.01 μF, 500 VDC ceramic	272-131
C4	40 μF, 200 VDC electrolytic	
R1	390 Ω, 1/2 W	271-1115
R2	220k Ω, 1/2 W	271-1132
R3	33k Ω, 1 W (sub. 3 100k, 1/2 W, in parallel)	271-1131
R4	1000 Ω, 1/2 W	271-1118
R5	10k Ω, 1/2W	271-1126
D1	200 piv silicon diode	
D2	400 piv bridge rect.	276-1173
Q1	2N2222	276-2009
Q2	NTE-171 or any similar NPN 300 V transistor	
F1	1/2 A fuse	270-1003
	Fuse holder	270-1281
T1	1:1 ratio 115 V power transformer (sub. a pair of 24 V transformers)	273-1366
RFC	2.5 mH segmented RF chokes or similar inductors	

Table 1. Suggested parts list.

For Computer Illiterates Only

Take a trip through your PC ...

Bob Shrader W6BNB
11911 Barnett Valley Road
Sebastopol CA 95472
[w6bnb@aol.com]

Amateur radio today is becoming more and more dependent on computers. We find them being used in such applications as sending and receiving CW, RTTY, AMTOR, and PACKET; keeping logs; substituting for *Callbooks;* computing antenna dimensions; and solving many other mathematical problems. They are very valuable, fast acting, complicated devices. But what's inside of one of these things?

First off, if you know much about computers, this explanation is not meant for you! On the other hand, if you feel that you know little or nothing about what is in a computer, you may find that this description of one reasonably complete Personal Computer (PC) will give you a basic idea of how one might be put together.

The block diagram of the PC shown is the result of some doodling done one day while I was thinking over the "486 CPU" type of computer my son assembled for me out of some spare parts he had lying around. He has been working for IBM for many years, but as a hobby he builds his own PCs. He has advanced from a 286 to a 386 to a 486 and finally to a Pentium™ CPU computer—hence all the spare parts he had on hand.

Actually, my knowledge of computers is pretty limited. The block diagram I have drawn up was originally done in hope of bettering my own understanding of how my machine works. I have found that I comprehend something a lot better if I put down on paper what I am trying to learn about it. This diagram illustrates the basics of my IBM-clone PC. Let me say right here that although there is probably no other PC in the world exactly like mine, there are millions of them that may be very similar in many ways.

In the block diagram, the outside case and the chassis of the computer are indicated by the dotted-line rectangle. Features shown on the right side of the rectangle are on the front of the chassis (the front panel), which also has some pilot lights and other switch buttons we will not discuss. All connections on the three other sides of the rectangle would be found on the back surface of the chassis and case.

The little female Vs shown on the chassis, or on other component edges, and their mating male arrowheads, represent cable or other plug-in connections. They are not all installed male and female as they have been diagrammed here for simplicity. Also, each single connecting line on the block diagram may represent anything from a two-wire pair to a 50-wire ribbon cable, or even a multi-contact plug-in board. We will not be getting too specific and authoritative—this is just going to be the basic ideas of what possibly might connect to what, and perhaps why.

Outside the dotted-line chassis and case are the peripherals—the video monitor, the printer, the keyboard, the mouse, and so forth. Inside the case, on the bottom surface of the chassis, and plugged into a very complex "motherboard," is the brains of the PC, the Central Processing Unit (CPU), in the form of a plug-in integrated circuit (IC). There are other circuits, mostly in IC form, that are also plugged into, or mounted, on the motherboard.

Let's start the explanation at the top left and move around clockwise. When the cable of the TV-like screen of the monitor is plugged into the fitting for it at the back-surface of the computer chassis, it couples to an internal electronic-circuit plug-in "interfacing" display card which in turn plugs into the motherboard as shown.

The three-wire male connector at the end of the AC line cord from the monitor unit plugs into a female AC receptacle on the back chassis surface of the computer (shown below the monitor). This female fitting is directly connected to the equipment side of the main AC on-off switch of the PC. The female end of an AC line cord is plugged into a male fitting connected to the line side of the PC's main on-off switch. With this circuitry, the monitor turn-on and turn-off is controlled by the computer's AC line switch, which is handy. Many PCs require their monitors to be plugged into a separate AC outlet and therefore require a second switch operation. While this may be no big deal, the single-switch scheme is a

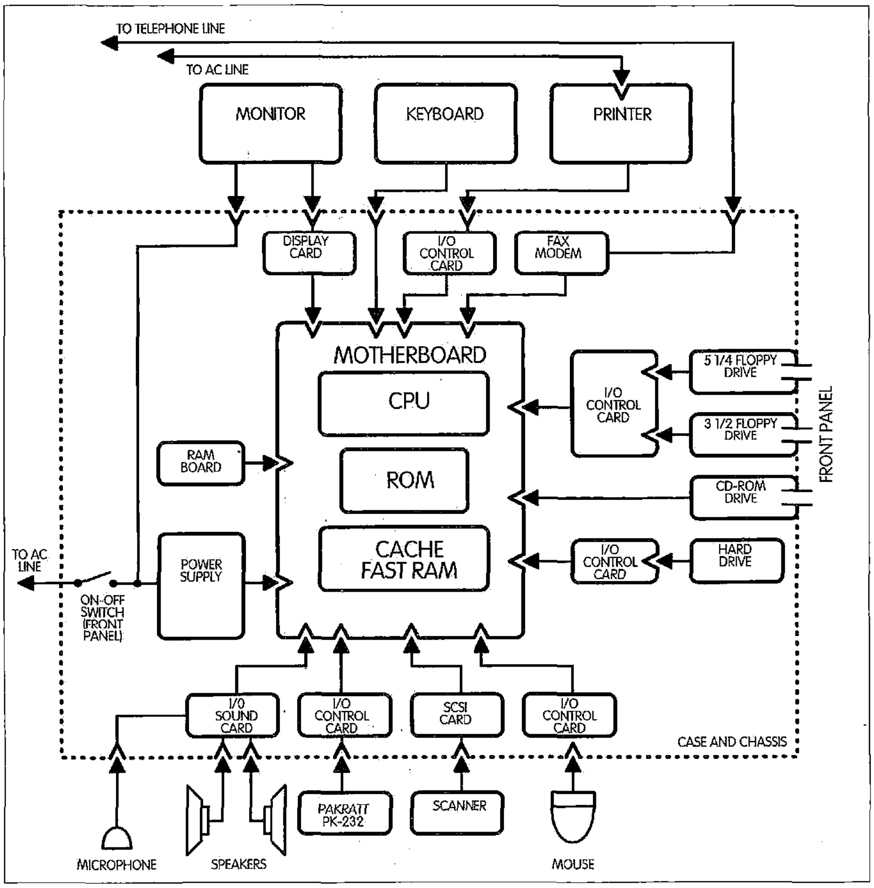


Fig. 1. Block diagram of the author's 486 CPU computer.

little nicety. Of course, a single-switch control is also possible if all computer units are plugged into an AC power strip and its switch is used to turn on and off all equipment plugged into it.

When the printer is plugged into the computer, it couples through a parallel-type input/output (I/O) controller card which in turn couples to the motherboard. Since a printer is not always turned on when a PC is in use, it is coupled to an AC line outlet with its own line cord and uses its own separate on-off switch.

When being used, the keyboard's electronically generated digital data signals are fed directly into the motherboard. From there data can go to memory banks where it may be stored or accessed when needed, or it may be fed to other destinations in the computer.

If a telephone line is coupled to the motherboard, it is done through a facsimile/data (FAX) modem (*mod*ulator-*dem*odulator) device. The modem stores in its memory the very fast 8-bit ASCII on-off, or 1-0, coded characters developed in the PC. However, the fast ASCII data must be changed to a much lower-frequency data stream in order for handling by the limited bandwidth (speed) capabilities of telephone lines and their circuits. My internally mounted modem plugs into the motherboard. In many computers, the modem is a peripheral device and is located outside the computer.

A movable, finger-operated control device, called a "mouse," can be moved around on the top surface of the operating position. It is used to move the arrowhead or the little blinking "cursor" dash which appears on the monitor screen. The arrowhead is used to point to whatever may be the next step in computer activity and the blinking cursor shows where the next typed character will be. Two switches on the top of the mouse (sometimes three) can control most of the computer's activities. The mouse is shown coupled to the motherboard through a serial-port I/O controller card. Many modern PCs may have series/parallel I/O controller cards built into the motherboard, so the mouse might be cabled directly to one of these serial ports.

If a scanner is used, it picks up digital picture signal bits (pixels) from any picture, or written page, that it scans line by line. The pixels are coupled to the motherboard through a "Small Computer System Interface" (SCSI—pronounced "scuzzy") card. With these signals the computer can transmit FAX picture signals into the motherboard, to memory, or to the monitor, or send them through the modem to the telephone line. FAX pictures can also be received through the modem to be held in memory, and then be shown on the monitor or printed in black and white or color on the printer.

When my Pakratt PK-232 peripheral device, which I use to transmit and display CW, RTTY, and other signals, is plugged into the computer, it couples to and from the motherboard through a serial-port I/O controller card.

An external loudspeaker (or two for stereo sound) can be coupled to an I/O sound card that couples to the motherboard. In some computers a single small loudspeaker may be mounted on the front or back surface of the chassis. I happen to have two external speakers for stereo, but one is really all that is needed for normal PC operation. A microphone, or an AF line, may also be plugged into the sound card to send voice or other audio frequency signals out through the modem to the telephone line or to be recorded on disks.

The AC line, through the main on-off switch on the front chassis panel, is connected to a power supply that converts the 120 V AC to the 5 to 15 V DC required to run the motherboard and the various inside-the-case devices. In many older and some newer PCs, the main on-off switch is placed in a hard-to-get-to position, such as far back on the right side of the case, so it cannot be inadvertently turned off and thereby wipe out a lot of RAM data. My front panel switch is fairly difficult to press in, so inadvertent turn-off is unlikely.

On the motherboard, among other things, will be the Read-Only-Memory (ROM) ICs, Random-Access-Memory (RAM) plug-in sockets, and some very fast RAM-type "cache" memory ICs. The data instructions that are recorded in the ROM are used to start, or "boot-up," the computer and keep it operating. The RAM memory holds much of what is typed on the keyboard after the PC is booted up. The cache RAM memory ICs hold only recently entered keyboard information. When working on a file (program of some type), the cache memory is searched first

before data is looked for in the much larger and longer-time-to-access RAM modules. (Remember, this is just my PC being discussed. Others may differ.)

"Disks" found in PCs will be:

(1) a relatively slow rotating, low data capacity, slide-in 5-1/4-inch "floppy" disk;

(2) a faster rotating, medium data capacity, slide-in 3-1/2-inch floppy disk;

(3) a very fast rotating, high data capacity, drop-in (the carrier) Compact-Disc-Read-Only-Memory (CD-ROM) disk; and

(4) a fast rotating, very high data capacity, internally installed "hard-drive" disk.

The original 5-1/4-inch floppy disks are somewhat flexible, hence their name. The newer 3-1/2-inch disks are also flexible and thus, even though they are permanently mounted in rigid plastic cases which cannot be bent, they are also known as floppy disks. While the CD-ROMs may be semi-flexible, they are not considered or called floppy disks.

The drive cases that accept the first three types of disks are mounted on the front panel. There are multi-wire ribbon cables coming out of the back of them, terminated with plug-in connectors that plug into I/O controller cards, unless the I/O circuits are built into the motherboard. (Note that all components normally added inside a computer are always either plug-in or screwdriver connected, requiring no soldering of circuits.)

All disk drive cases contain little internal motors that rotate the disks when they are inserted. Each floppy drive has a "read" head to pick up digital data from the tiny north/south magnetized areas laid down on concentric-circle tracks on the rotating disk surfaces. Their "write" heads can lay down north/south magnetized areas on the same tracks if the disks are "formatted" (data erased). Present CD-ROMs are recorded with tiny high-low pits that get their on-off data by reflecting light or not, instead of having magnetic north/south recorded areas to produce their on-off signals. The pits on CD-ROM spiral tracks do not allow re-recording on them.

The hard-drive disk with its rotating mechanism and magnetic RAM-type read/write heads are in a rectangular metal box mounted somewhere on the chassis inside the computer case. It is plugged into an I/O controller card with a 34-wire, or more, ribbon cable and then into the motherboard. A hard-drive disk can store vast amounts (megabytes or gigabytes, meaning millions or billions of bytes) of data in digital form which is not lost when the computer is turned off. (A "byte" is an 8-bit word. A "bit" is one north/south or on-off recorded bit of information.) When a PC is turned off, the IC-type RAMs lose all of their stored data, which can mean disaster if power failures occur. Magnetically stored memory data is not affected during equipment turn-off or power failures.

Older PCs may only have the hard-disk drive and one or two 5-1/4-inch floppy disk drives. Later PCs may have the hard disk plus a 5-1/4-inch and a 3-1/2-inch floppy disk drive. Still newer PCs, like mine, besides the hard disk, may have a 5-1/4-inch floppy, a 3-1/2-inch floppy, and a CD-ROM disc drive. Many of the newer PCs may only have a 3-1/2-inch floppy and a CD-ROM in addition to the internal hard disk. The CD-ROM and the floppy disks can be slipped into the long, narrow slots on the face of their drives that are mounted on the front panel of the PC. Disk-drive slots are represented by the parallel-line openings shown on the front panel face of the block diagram rectangle. It is into these slots that the thin, round plastic disks inside their square handling holders are inserted. These disks must be mechanically locked in before they will operate.

As I stated before, this explanation has been just a basic PC discussion. There are many other things in PCs, such as oscillators, timing circuits, etc., that have to be in there, but have not been mentioned. There may be many other types of PCs that are equal to or better in some respects than the IBM clone discussed here. Every day it seems something new comes out regarding PC hardware (devices). New amateur radio applications and programs (software) are continually being dreamed up. Trying to remember all of the things that must be done just to operate even a simple PC properly is a major challenge. This is particularly true for those poor souls who fit into the category of being from one of the older generations! (Your writer was first licensed in 1931 and knows whereof he speaks.) Besides my son Douglas, two ham friends, George Littrell W6ABU and Wil Senior K6SEZ, were kind enough to give me some valuable comments and corrections on the explanations I have provided here. These were all greatly appreciated.

PROPAGATION

Jim Gray W1XU
210 E Chateau
Payson AZ 85541

The best days (G) for propagation this month are likely to be the 5th through 9th, the 18th and 19th, and 28th through 31st. The worst days (P) are likely to be the 10th through the 12th, and the 23rd through the 26th. The remainder of the days ought to be fair (F) or trending as shown on the calendar. Look for possible geophysical upsets such as unusual weather, or earthquakes and volcanism around the 10th and 25th.

10–12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15–17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the US.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30–40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar). Short-skip during darkness to 1,500 miles or more.

160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked G on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet.

OCTOBER 1997						
SUN	MON	TUE	WED	THU	FRI	SAT
			1 G	2 G-F	3 F	4 F-G
5 G	6 G	7 G	8 G	9 G-F	10 F-P	11 P
12 P-F	13 F	14 F	15 F	16 F	17 F	18 F-G
19 G	20 G-F	21 F	22 F	23 F-P	24 P	25 P
26 P-F	27 F-G	28 G	29 G	30 G	31 G	

EASTERN UNITED STATES TO:												
GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		
CENTRAL UNITED STATES TO:												
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20
WESTERN UNITED STATES TO:												
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

Including Ham Radio Fun!

NOVEMBER 1997
ISSUE #446
USA $3.95
CANADA $4.95

International Edition

73® Amateur Radio Today

Ildi HAØUZ

Review:
EMTECH QRP)

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article [IBM (ok) or Mac (preferred) formats], carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

NOVEMBER 1997
ISSUE #446

Including Ham Radio Fun!

73® Amateur Radio Today

TABLE OF CONTENTS

FEATURES

REVIEW

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: XYL Ildi Bogyo HAØUZ shares this shack with OM Steve HAØDU in Debrecen, Hungary. Photo by George Pataki WB2AQC. Send us your possible cover shot photos, gladly returned if not purchased.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The entire contents ©1997 by 73 Magazine. No part of this publication may be reproduced without written permission of the publisher, which is not all that difficult to get. The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

The End Is Near!

The end of the year, that is. You're probably reading this in October, Halloween month. The cover is dated November, which means Thanksgiving is coming soon. And that means just one more month until Christmas. And a week after that is New Year's Day, when you're supposed to make all those resolutions. You know, the promises to better yourself that you aren't going to keep.

Alas, we all seem to work on the same system as our big corporations, thinking at most about a quarter of a year ahead. If we had any interest at all in the long range, we'd immediately change our diets, get the mercury out of our mouths, the lead out of our pants, and so on. All that stuff I've been preaching. All that stuff you've been snoring through.

Sure, our ham radio contests are fun. At least for a few of us. For the rest they can be a royal pain. For the very few they're *important*. They buy their stations around winning contests. But then there are a few severely misguided souls who think that working DX is *important*. Making momentary contacts with hams in rare countries for the sole purpose of getting a QSL card doesn't hold up for me as *important*. Hey, I've been there, done that. I recently ran across a big carton of my old QSL cards out in the barn. Sure, working some of the rare ones was fun, and I once used my cards from around 350 countries to dress up a book I wrote on how to work DX. And when I get my Silent Key Award from the ARRL my cards will go in the trash, along with all that other ham junk in the barn.

With the new sun spot cycle starting, and with the end of the world coming due in one, two or 10 years, depending on which Art Bell Show doom-meister you believe, can I sell you on trying something new this winter? It could be your last chance!

For instance, how about trying your hand at some ham satellite contacts? Then write me a letter and tell me how you went about it and how much fun you've been having.

Say, have you ever tried making aurora contacts on two meters? I've got it on good authority that there have been several darned good auroras this summer with no one in there making contacts. No one! Yes, you do have to either know the code at around 5 wpm, which is about as fast as code can be sent via the aurora, or use sideband. Try it and write to me. A CW signal comes through as pulses of white noise and sideband sounds like someone whispering.

If that's too exciting for you, how about getting on six meters and letting me know what you've worked? I hear we've been getting some interesting openings into South America.

Have you ever mountaintopped? I've had some great adventures operating from the top of Mt. Greylock in Massachusetts, Mt. Mansfield in Vermont, Mt. Washington in New Hampshire, and Cadillac Mountain in Maine. Do it and let me know how you make out. Send some photos too. Heck, I remember when a New Jersey club would make weekend mountaintop expeditions and rack up hundreds of contacts. It was a one-club contest.

If you are inactive, make a Halloween resolution to get on some new band by Thanksgiving. All it takes is a dipole to get started. And let me know what you find. Is it fun? Or boring?

Can I get you to start bringing up interesting subjects to talk about on the air? What I've been hearing on 20 meters lately sure hasn't encouraged me to put up a better antenna. It isn't like I haven't been providing you with stuff in my editorials. And if you tape the Art Bell Show every night you'll have still more ammunition. And if we do hook up on 20, please don't tell me what rig you've bought, or about your antenna—unless I specifically ask (which I guarantee I won't).

If the doomsayers are right, you don't want to spend your last hamming days swapping QSL information, and 73, thanks for the contact, do you? Oh, you do? Okay, never mind.

Take the Express!

Why take the local through life, stopping at every stop and taking forever to get there? Yes, there *is* an express! There's a fast track to health and wealth—to success. The good part of the fast track is that few people know about it, so you'll have very little competition. The bad part is that not only don't other people not know about it, they don't even believe it's there. They totally believe that the slow track is all there is—the track that takes you through four or five years of college and a lifetime of working for someone else.

If you haven't heard the cliché that "you'll never get rich working for someone else," it's high time you not only hear it, but give it some very serious thought. When you work for yourself not only can't you be fired, downsized, or outsourced, you are the one setting your own salary. And there's no one to ask you whether you have a degree in anything or not.

Sure, there are a bunch of self-employed people who are never going to make much money. Working for yourself isn't a total answer, you also want to be picky about what kind of work you're going to do, making sure that it has the potential for both making a lot of money and for providing you with some freedom to enjoy it. I'm talking about some sort of entrepreneurial enterprise other than running a grocery store or restaurant.

How do you find the product or service which is going to put you on the fast track? And how do you build all of the skills you'll need to run your business successfully? By going to college? None that I've found yet! And not for a lack of looking. The fact is that colleges don't want you to know how much of a waste of your life a college degree is when it comes to being an entrepreneur, so they're not about to teach such dangerous ideas.

No, if you want to take the express you'll want to start early and learn what you need to know with someone else paying the bills. Learn on Other People's Money (OPM). That's why I recommend starting as early as you can as an apprentice (a.k.a. trainee) with a small entrepreneurial company in a field that's more fun than work for you, making it your business to learn everything you can about the business.

I've lectured on this at Yale, Rensselaer Polytechnic Institute, Case-Western University, Babson College, Boston University, and a bunch of other colleges, but for some reason they don't ask me back. Oh, the kids love my talks—it's the professors who aren't enthusiastic about 'em. Hey, let me know if you ever find a college professor who has given up a successful life as an entrepreneur to teach.

Medical Science?

Medical "science," like all the other so-called sciences, has a long and almost unbroken history of rejecting new ideas. You've probably read about Semmelweis, who was ostracized by his colleagues and fired from the hospital for recommending that doctors wash their hands before assisting in births. And then there was Pasteur and his stupid germ theory.

But I'll bet you haven't heard about Laennec, a young Frenchman who invented the stethoscope. His colleagues ridiculed him and suggested that it was the work of the Devil. He used a

rolled-up paper cone, which left a red ring. Witchcraft!

Alas, 150 years later little has changed. Doctors are still resisting new ideas, so is it any wonder that medical "science" is still fighting cancer with surgery, radiation, and chemotherapy (poisons), despite abundant evidence that *all* cancers are caused by our diets?

How many women would give up eating chocolate if they knew the connection between chocolate and breast cancer?

Since your present diet is around 99% guaranteed to give you cancer or a heart attack, nothing I can write is going to change you. Dr. Schweitzer never saw a case of cancer among the African natives until the white man's diet was introduced. Dr. Stephenson found the same among the Eskimos. Hey, I'm thirsty—pass me a cold Coke®.

When people get sick they want something done, and quickly. Prompt relief is what they want. Very few people want, or are interested in, a cure. What they want is relief from bothersome symptoms, and at any price. So doctors continue to practice palliative medicine, which seldom produces a cure. They get rich and we get sick and die 20-30 years before we need to. Well, it's good for Social Security, the insurance industry, the HMOs, hospitals, AMA, FDA, NIH, WHO, the National Cancer Institute, General Foods, General Mills, and on down the line. The only downside is us, and we don't seem to care one way or the other.

Smoking

Despite the best efforts of the tobacco industry, their thousands of lobbyists, and flocks of scientists paid to see no evil and suppress the facts, we are seeing more and more evidence of the massive cover-up conspiracy between them, our government, the medical industry and the insurance companies.

We now know that nicotine produces temporary stimulation at first, but fatigue, depression, nervousness, diminished reflexes, impaired reasoning capacity and loss of memory follow after a few years. We also know that it's one of the most addictive substances yet found.

But we're slowly making headway. If you watch the old movies you'll see all of the stars smoking cigarettes. In today's movies, when someone lights up you know right away that this is a bad guy. Remember *Waterworld*, with the bad guys being the "Smokers?" And the very worst villain on the *X-Files* is the Smoking Man.

When I see kids smoking these days I know (a) they are stupid, and (b) their parents are not much interested in them.

Yes, it's an extremely difficult addiction to kick, but the fact is that millions have succeeded in stopping so, unless people's motivation and determination have been gutted by our school system, anyone *can* stop.

Music Soothes

In addition to the usual poisons you've been putting into your body, plus your pathetically lousy nutrition, another killer is stress. Yes, old Doc Green is going to prescribe music as one of the better ways to reduce stress. And I don't mean rap or rock, either. I'm talking about classical music, and it doesn't get much more soothing than some of that. Just wait'll you get a load of some of the incredible music Delius wrote! And Gottschalk!

The fact is that every disease we come down with has a psychological component, so if you can get rid of that trigger, your body will usually be able to surmount the immediate infection. As Béchamp, Rife, Naessens and others have discovered, it's more a weakness of the body that brings on illness than an infection from outside.

Back when I was publishing the country's leading music magazine I found that the startlingly superb sound of compact discs had substantially increased the public's interest in classical music. The problem was that there were tens of thousands of classical CDs available and the newcomers didn't know which were best to buy. So I sat down and put together a recommended 100 CD classical music library—of music that time and millions of music lovers have proven to be the very best of the classics.

I originally wrote it as a series of five articles for *CD Review*, but I've now put the five together into a 20-page booklet.

What are the cream of the cream of symphonies, overtures to operas, ballet music, tone poems, concertos, dances, marches, and piano music? You'll find my guide to your stress reduction helpful in sorting out the wheat from the chaff. And even Beethoven wrote a bunch of chaff. Ditto Mozart.

If you don't know Zoltan Kodaly from Ketelby or Kabalevski, just let kindly old Doc Green sort it out for you. Send for my $5 Guide to Classical Music and start getting your mind into some kind of shape. I prescribe at least 30 minutes a day of brisk walking, and another 30 of stress reduction with the classics.

Educating Our Own Children

With the day of the pre-nuclear family long gone, with fewer and fewer families being able to get by with only one breadwinner, how can we give our kids a decent break in education? With most jobs these days requiring parents to be away from home for at least eight to nine hours—most of the waking hours for younger children—even if parents knew what best to teach their children, they're not around to do it. This is a situation parents have to recognize and come to grips with.

As I've pointed out, by far the most critical years for children are the earliest. This is when the patterns of a lifetime are established. Firmly established. No amount of remedial work later on is ever going to completely erase a mindset that is developed in these first few years. This is when the exposure to mind-expanding experiences help their brains to build the neural circuits which will allow them to cope with language, reading, and other such critical skills. Once this window of opportunity has passed, it's closed forever.

Thus you can see how millions of children are being permanently hobbled mentally (brain damaged, if you will) by the lack of good early education. Working parents find a nearby day-care center and park their babies for nine or 10 hours a day. With few exceptions, day-care centers tend to be just that and little more. They keep the babies and young children in their care fed and dry and as quiet as they can. How many parents have ever spent a whole day at their children's center to see what goes on? One in a hundred? One in a thousand?

Babies need personal attention. They need love. They need someone to read to them. They need to be held. They need toys to attract their attention and involve them. They need to be encouraged and congratulated when they try something new. They need to experience what success feels like. They need to learn how to be adventurous. They need to understand that failure is all part of eventually winning and not to be feared. They need to understand that they are different and that this is good. They need to find out that they can do almost anything they believe they can.

Yes, this is a lot to expect from a day-care center. But no day-care should provide any less! This is why I've recommended that we enlist the help of retired people, of the elderly from nursing homes, and that mothers start job-sharing so that one can help with day-care in the mornings and the other afternoons. These families will have one and a half pay checks instead of two, but they'll know that their children are getting the best possible start in their lives.

With day-care like this I believe we'll be headed toward a country with fewer poor, much less crime, less drug problems, and with more highly motivated kids, eager to get all they can from our educational system.

Have you noticed that whenever we can't pay attention to something it seems to fall apart? Well that certainly holds for educating our babies—and our children. We haven't been paying attention. For some reason we seem to feel that even though our government has failed us in almost every other way, at least as far as education is concerned we can depend on it. Well, it's doing education as poorly as it's handling our banks, the deficit, and almost everything else we see exposed in the news.

Your children are going to get a good education when you pay some attention to them and start trying to change the system which our collective neglect has allowed to strangle our country. It's our educational system which is at the bottom of virtually all of our problems. It's been making the poor poorer. It's been decimating our cities. It's been encouraging more and more jobs to be exported.

If our babies had been properly educated we wouldn't have

Continued on page 8

QRX . . .

Amateur Radio Needs Dramatic Rethinking

It is tempting to conclude that threats to amateur radio come from spectrum auctions alone. But the problem is more complex than that. What if nobody wants to become an amateur radio operator? What if our "product" is wrong and there are no buyers? No amount of fiddling with our marketing—or license structure—will sell the product if we have the wrong product to sell in a world awash with interesting and competing technologies.

From a public relations perspective, should the amateur service even be called that? The word "amateur" has negative connotations ranging from inexperienced, cheap, low quality, unreliable, to worse.

Amateur radio has changed little in 30 to 40 years. Today's amateur radio service relies on technology that is "old" and not spectrum-efficient. FM is 50 years old; SSB is 40 years old; CW is over 100 years old and 1200 bps AX.25 packet is based on the 15-year-old obsolete "dumb terminal" rather than personal-computer-based networking. Yes, these technologies still work—but how do we advance from here? Regulatory structures and our "voluntary" band plans stifle innovation and institutionalize the status quo. The result: We are growing stale as the world rushes by.

Not long ago in the US, regulations prohibited use of the popular ASCII code for computer data.

Current regulations place burdens on spread-spectrum (SS) systems—techniques that are now state-of-the-art in unlicensed wireless systems and some cellular phone networks (our homes' cordless phones use direct sequence spread-spectrum). FCC 97.311 requires that you "Maintain a record, convertible to the original information (voice, text, image, etc.) of all spread-spectrum communications transmitted" for *a full year*. You cannot realistically use SS technology for routine amateur communications unless you are prepared to maintain a copy of every transmission you ever made. By law, we are *prevented from adopting state-of-the-art technology* for routine amateur communications.

Paradoxically, you can operate an unlicensed SS transmitter at a one-watt power level in the amateur bands at 902, 2400 and 5725 MHz, and do anything you want—but not as an amateur station! Part 15 SS devices sharing the amateur bands can do anything they want. Does this make sense to you?

In 1996, the Tucson Amateur Packet Radio group had to fight hard for a special temporary authority to operate direct sequence spread-spectrum communication technology in the amateur bands. While the ARRL said it supports TAPR's efforts, it then opposed most of the details in the TAPR proposal.

Legally, you can transmit digital data using data compression—but you must "maintain a record, convertible to the original information, of all digital communications transmitted" *forever*. Does this make sense?

Part 97 effectively prohibits amateurs from adopting modern digital communications. Yes, you can experiment, but forget about widespread adoption of your inventions.

The Part 97 rules contain outdated notions of amateur emergency communications. Strangely, the "RACES" rules limit amateurs to a maximum of one hour per week of participating in RACES training (except that twice per year you can apply to the government for special exemption to this rule). When your government runs a mass casualty drill that lasts a full day, you can hardly walk off the job an hour after arriving. The RACES rules are oriented towards an historical amateur service consisting of large, fixed-location, point-to-point HF operations—yet most RACES operations take place at VHF and above.

Only recently was FCC 97.113 written to clarify the legality of calling a tow truck for a motorist whose vehicle is disabled on the side of the road. Poorly thought out rules led to situations where amateurs questioned whether it was okay for hams to provide emergency communications support for disasters—wasn't this just helping a fire department in its *routine business* operations, and aren't business communications prohibited? Sigh.

By Ed Mitchell KF7VY, found in the *Brandon Amateur Radio Society Newsletter*, May 1997 issue. They reprinted it with permission from *Ham Radio Online* magazine, available for free on the Internet at [http://www.hamradio-online.com].

The Doctor is Destinated: Questions & Answers for the New Ham

Q. A repeater expert told me that my signal would hit him better if I was horizontally polarized. Now when I go for my walks I tilt my head sideways to talk into my HT. This makes me dizzy. Do you have any suggestions?

A. Actually, you can never really determine at what angle your modulations will hit the repeater. Circular polarization is probably the most reliable. To achieve this, the Doctor suggests that when you go for your walks you hold your head straight up, but you should walk in little circles.

Q. When I listen on the repeater, I often hear guys saying strange things that start with Q, like Q Artie, and QS Why, and QS Elle, etc. What do these things mean?

A. In the old days of radio, before hams were invented and they had to do it with flags, they had special three-letter codes called Q-signals, which had specific meanings. Fortunately, it is now the '90s, and we live in America where we have freedom. Just as you no longer need to actually learn anything to get your ham license, you can use Q-signals to mean anything you want. So if they use ones you don't understand you will just have to ask them—preferably using a Q-signal such as QQQ?—meaning "Huh?"

Q. I live in California and my wife just got transferred to Illinois for her job. We are both hams. I am a Tech plus and she is only a Tech. What is the best way for us to communicate—should we use the 2-meter, or satellite, or what?

A. Actually, neither. The Doctor suggests that you look through her stuff and see if anything has her new address on it and a big number, at least 10 digits long. This is called a phone number. When you punch it into your phone, the phone will automatically seek out the best repeater for your comms.

Each month the Doctor will answer the most interesting questions from readers. Questions may be edited for length and clarity, which is why many of them disappear altogether.

Author anonymous. TNX *Low Down*, official journal of the Colorado QRP Club [cqc@aol.com].

Theft Deterrent System on Ham Bands?

The FCC has received a Petition for Rule Making from Checkpoint Systems, Inc. The company wants the Commission to permit electronic article surveillance operations in the 1.705 to 30 MHz band. This, at a fairly high maximum radiated emission level.

Checkpoint Systems is the manufacturer of some fairly sophisticated electronic article surveillance systems that use frequencies in the 1.7 MHz to 10 MHz range. It is regulated as an unlicensed intentional radiator under Subpart C of Part 15.

Under Part 15 rules, such devices may operate without restrictions on bandwidth, duty cycle, modulation technique, or application, but must comply with specified radiation and emission limits and protect licensed services from harmful interference. But Checkpoint says it needs the higher power levels to overcome what it calls the increasing levels of ambient RF noise in commercial establishments. The expanded frequency range, the company says, will allow for greater flexibility in deploying EAS systems and reduce the potential for false alarms.

Checkpoint already holds an experimental authorization to operate EAS equipment within the 7.4 MHz to 9 MHz and 8.2 MHz to 10 MHz bands at higher power levels. The company says it has received no complaints of interference. Its Petition for Rule Making was received by the FCC on April 28.

From FCC, ARRL, via *Harmonics*, newsletter of South Jersey Radio Association, June 1997.

CQC Top Ten Reasons for Running QRO (High Power)

10. I can tell all my neighbors about my ham radio activities by direct input to their TVs, radios, and telephones.

9. My tuner will handle a kW and it would be a waste of capacity not to use it.

8. Everyone in the world needs to know that I have more dollars than sense.

7. Why kill two birds with one stone when I can kill *all* the birds with one kW?

6. A kW or two gives me a real edge in those QRP contests.

5. Keeps those pesky QRP guys from getting too close to *my* frequency.

4. A signal report is meaningless unless it includes "dB over 9."

3. The linear keeps my coffee warm.

2. The lights flicker so I know I really am getting out.

And the number one Reason for Running QRO:

1. Two words: Sexual Insecurity.

From *Low Down*, official journal of the Colorado QRP Club (cqc@aol.com).

My Radio Ham

The wife of Charles Brown N5CB has written a poem which expresses, we're sure, the feelings of many of our XYLs—or should we call them Amateur Radio Widows? We can be sure it was written with love. It appeared in the April 1996 *CQ* and is shared with you by permission of N5CB.

My Radio Ham
By Doris (Betty) Brown

I'm married to a man who's a radio ham.
He messes up my TV and doesn't give a damn.
I get on the phone and nothing's clear,
He yells, "Betty, it ain't coming from here.
Something's happening in the atmosphere,
Hang up the phone for a while, my dear."
He says, "I'm trying to work this station and there's a mighty jam."
But you know how it is with a radio ham.
He used to have a job with Uncle Sam,
But he gave it all up to be a radio ham.
He's got a big mouth, boy can he shout,
I'm always glad to hear when it's "Over and out."
I get real mad and he knows I am.
Doesn't bother him, he's a radio ham.
He sits there listening with those things on his head,
If I didn't know him I'd think he was dead.
His code rings out loud and clear,
A sound that's music to another ham's ear.
He talks to Moscow and Amsterdam,
Let's everyone know he's a radio ham.
One day I'm gonna give him a big black eye,
Cause he ain't done a thing about this TVI.
I'm stuck with him and he's stuck with me,
Guess I'll never stop hearing "N5CB."

From Pelican Bay Amateur Radio Club's May 1997 *PBARC SPARKS*.

NJ Judge: Ham Interference Out of His Hands

A New Jersey Superior Court judge has ruled that federal law prevents him from declaring ham radio interference a nuisance. Judge Reginald Stanton made that determination in a case reported April 16 in the New Jersey *Star Ledger*, in which a couple sued their neighbor, Walter Kornienko K2WK, of Lafayette NJ, claiming his transmissions interfered with their telephone, TV, and garage door opener. The couple, Leopold and Karen Korins, was trying to get Stanton to declare the situation a nuisance and to direct Komienko to cut back on his hobby. But Kornienko's lawyer claimed his client had a right to operate under a federal license and suggested the Korins do more to shield their appliances from RFI.

"There is no question that there has been meaningful intrusion into the Korins' home and their expectations of enjoying a reliable and reasonably high quality level of telephone and television reception," Stanton is quoted as saying in the *Star Ledger* report by Bill Riley.

Stanton conceded that the FCC had jurisdiction and he had no authority to limit Kornienko's hamming. "If he is obeying the FCC rules and the Korins can't fix the situation in their home, that's tough," Stanton reportedly said.

Reprinted from *ARRL Electronic Letter* in the May 1997 issue of *Harmonics*.

Isn't That Special?

The FCC will allow a licensee to substitute a self-selected callsign from the block of 1x1 callsigns for temporary use during a special event operation. The station must announce its regularly assigned callsign at least once an hour. The special event callsigns will be coordinated and issued by outside volunteer entities, not by the FCC.

The FCC has raised the eligibility requirement from at least two members to a minimum of four. Applicants for a club station license must have a club name, a document of organization, management, and a primary ham radio purpose that's consistent with FCC rules.

Responding to a petition by the National Conference of Volunteer-Examiner coordinators (NCVEC), the FCC said VECs could elect to designate a session manager if they wanted to, but they would not be required to do so.

Another change will allow hams to include a self-assigned indicator before, after, or both before and after the assigned callsign, when identifying. Current rules only permit using such indicators after the station's regular callsign. Self-assigned indicators include those used to indicate location or type of operation, such as /KP2 when operating in the US Virgin Islands or /m when operating in a vehicle. They also can denote participation in an unusual event or other atypical station operation, according to the FCC.

The FCC announced all of the rules changes in a Report and Order, FCC 97-99, adopted March 20 and issued April 1, 1997. The amendments become effective 30 days after the Report and Order is published in *The Federal Register*.

TNX to the May/June 1997 issue of the *Pine State ARC* newsletter for finding this in the *ARRL Letter*, Vol. 16, No. 14.

Darwin Award Winner Announced

For those of you who are not familiar with the Darwin Award, it's an annual "honor" given to the person who did the gene pool the biggest service by killing himself in the most extraordinarily stupid way.

The 1995 winner was the fellow who was killed by a vending machine which toppled over on top of him as he was attempting to tip a free soda out of it. In 1996 the winner was an Air Force sergeant who, feeling the need for speed, attached a JATO unit to his car, managed to get airborne—and crashed into a cliff several hundred feet above the roadbed. And now, the 1997 winner: Larry Waters of Los Angeles—one of the few Darwin winners to survive his award-winning accomplishment.

Larry, who always wanted to fly, decided one day that he would try it in his own back yard. He went to the local Army-Navy surplus store and purchased 45 weather balloons and several tanks of helium. Back home, Larry securely strapped the balloons to a more or less sturdy lawn chair. He anchored the chair to the bumper of his jeep and inflated the balloons with helium. Larry's plan was to lazily float up to a height of about 30 feet above his back yard after severing the anchor and in a few hours come back down. Satisfied that his "flying machine" would work, Larry packed several sandwiches and a six-pack of Miller Lite™, loaded his pellet gun—figuring he could pop a few balloons when it was time to descend—and went back to the floating lawn chair and tied himself in along with his pellet gun and provisions.

When he cut the cord anchoring the lawn chair to his jeep, he didn't float lazily up to 30 or so feet. Instead, he streaked into the LA sky as if shot from a cannon. After a thrilling climb, he finally leveled off at an altitude of 11,000 feet. At that height he couldn't risk shooting any of the balloons, lest he unbalance the load and really find himself in trouble. So he stayed there, drifting, cold and frightened, for more than 14 hours. As he drifted into the air space controlled by LAX approach control, a United Airlines pilot spotted Larry and radioed the tower that he had just passed a guy in a lawn chair with a gun. Radar confirmed the report.

As Larry slowly floated above LA and out over the Pacific, LAX launched a helicopter and sent it in hot pursuit. Once the helicopter crew determined that Larry was not dangerous, they attempted to close in for a rescue. Finally, ascending to a position several hundred feet above Larry, they lowered a rescue line. Larry snagged the line and was towed back to shore.

As soon as Larry was hauled to earth, he was arrested by waiting members of the Los Angeles Police Department for violating LAX restricted airspace.

TNX to Bill Moore of Melbourne FL, who forwarded this to *Harmonics*, newsletter of the South Jersey Radio Association (May 1997 issue), from which *we* appropriated it.

This Is Only a Drill

The ARRL wants the FCC to allow hams actively supporting emergency or disaster communications or involved in drills and tests to communicate "between and among" RACES stations and those stations registered with civil defense organizations operating under RACES. The League also wants the FCC to relax time limitations on RACES emergency drills and tests. This would permit stations operating under RACES to communicate as necessary, during emergencies, tests, and drills, with non-RACES stations also engaged in emergency communication or drills.

ARRL Letter, Vol. 16, No. 12; TNX Pine State ARC.

Number 8 on your Feedback card

LETTERS

From the Ham Shack

Dan Lakenmacher N5UNU. You made some interesting observations in your editorial that discussed hamfests (among other things). You asked for ideas and comments from your readers.

Let's start with an idea that works at hamfests. Either get a table to sell gear or carry something to sell. By providing a conversation opener you will meet people who might otherwise have been too shy to talk with you. Don't walk down the center of the aisles glancing quickly from side to side. Inspect the merchandise. Don't be afraid that someone will sell you something that is not up to specs. That's life in the big city. Buy and sell. You will learn a lot. If you have a table I see nothing wrong with selling one or two items that are not directly ham related, though I personally abhor the sale of craft items or jewelry. You will benefit by offering a variety of gear and if you price an item fairly it will usually sell and you will have a great time and meet some new folks. You have to give a little to enjoy a hamfest.

Another idea. My wife often mans my table so I can run around, spend money and get new ideas. Linda AB5RI loves to meet and talk with people and they like to talk with her. She usually sells everything on the table and she gets to keep all the money. Why not? Linda has friends all over Texas, Oklahoma, Louisiana, and Montana that she met at hamfests. Linda doesn't talk about temperature, antenna type, name of rig, etc., but instead she talks about what the other person is interested in. Auntie Mame put it better than anyone when she said, "Life is a banquet, and most sonafabitches are starving to death."

Wayne, you asked for the name of a good speaker. I'll give you the name of a man who is always prepared, has great visual aids, combines enthusiasm and practicality with a true understanding of how brief our attention spans really are: Press Jones, The Wireman. I have never listened to Press without learning something that benefited me as a ham. I would especially recommend his demonstration of resonant antennas using a miniature transmitter and receiver and various antennas, etc. As in everything else, Press gives all the credit for this demonstration to someone else.

You aren't the only one who can ramble, Wayne. I've written two letters to you and you printed both. I'll bet you print this one, too.

You win ... Wayne.

Reed Reisner W7FXG. I read René's book and it completely changed my mind about NASA. René says that space is too hot for humans. I am 73 and have been poisoning myself all my life, thanks to our food marketing system. I am a retired electronics instructor. I was in the Merchant Marine as a radio man and have circumnavigated the globe, though I'm far short of your 132 countries visited.

On cold fusion, I believe in it. If I were 20 years younger, I'd start to learn a new discipline. On John Taylor Gatto, my wife and I taught school for the Los Angeles City School System and in Utah. We could write our own book on how rotten the system is and why we've lost our country. How about New Hampshire: Do the teachers there tell the truth about the Fed? I doubt it!

Of course not, but then I don't think any of them know the truth about the Fed. Very few people do ... Wayne.

Jim Maricle W7DQM. I have been a subscriber to *73* almost from its inception. I enjoy your editorials and look forward to reading same each month. In particular, I not only enjoyed, but find that I have had the same feelings about government's intrusion into every fiber of our existence as you describe in "Dim Bulb," Sept., page 47. Let it be known that your voice is not alone in the wilderness. Similar views can be found daily on Rush Limbaugh's radio broadcasts. There is a station on satellite TV that devotes its entire programming day to enlightenment of viewers as to what our government is doing to us to increase the bureaucracy. The station, NET, can be found on Satellite W-1 (GE-1, 103 degrees west, Channel 19). I personally am writing periodic E-mails to my congressman, Newt, Forbes, my senator, talk show hosts and, most importantly, to the editor of our newspaper. Please keep up the good work that you are doing by recognizing for your readers that regardless of party, every move our overblown government makes is political.

But can we take back our country from the politicians? ... Wayne.

William McConnell KD4UUB. I have just read KB9FO's article in the September issue of *73* ("Explorers, Adventurers, and Experts"). It is the most reasonable, logical and promising proposal I've read for reviving the amateur radio service. I would make just one suggestion. It is my observation that there are two categories of hams: "techies" and "talkies." "Talkies" are those who contribute most to amateur radio as communicators and operators. "Techies" are those who like to build their own gear and experiment with equipment and modes. My suggestion is that KB9FO add more "merit badges" for experimentation and home-brewing to his proposal. The ham community should get behind KB9FO's Petition for Rule Making and encourage the FCC to give it the serious attention it deserves.

NEVER SAY DIE

Continued from page 5

millions on welfare, millions more on unemployment, all watching sitcoms, ball games, game shows and soaps to pass the time as painlessly as possible until death them do part.

Yes, I know that every day at work is important, but if you had a death in the family, could you take off a day? Well, you *do* have a death in the family—it's your child's incremental death. So take off a day now and then and spend it with your baby at the child-care center and see for yourself what's going on. You may want to take another day off and see what's going on in another center, to see if it's better or worse. Then, after seeing what's going on, you may want to quit your job and open a more intelligently-run center yourself.

In many centers you're going to see babies and youngsters sedated with television. Hours and hours of TV. Sesame Street, Mr. Rogers, and cartoons. I've already explained why these programs are so disastrous for kids, despite their shelves of awards. If you want to find out more about all this I suggest you read *Endangered Minds* ($11) and *Your Child's Growing Mind* ($10) both by Dr. Healy. The first is from Simon & Schuster, the second from Doubleday. Get 'em, dammit!

If you got a call from the center saying your child was sick, could you spare the time to go help? Well, your child *is* sick—and needs your help. Your child is being permanently crippled, a little bit at a time. Of course you can wait it out and wonder why your child "went bad." What did you do as parents to rate this lazy, rock-music immersed, pot-smoking, beer-drinking teenager? Hey, *you* created this monster through your neglect.

With a high percentage of homes fatherless, working mothers have an even greater problem. Surveys have shown that fatherless kids tend to do much more poorly than those with two parents. I'm convinced that when we have a generation of better-educated kids we'll have fewer divorces and fewer one-parent homes. I think we can credit the increase in divorces to our lousy educational system.

Yes, there are other factors which permanently damage children—such as starting off with damaged genes from both parents resulting from their use of alcohol, nicotine, caffeine, and other drugs. Then there's the nine months of pregnancy, where the mother's drug use and poor nutrition both can damage the child irreparably, both physically and mentally.

The Sudbury Valley-type schools accept kids as young as four. Unless you really hate your children and want to do what you can to punish them for lousing up your life by being born.

Continued on page 40

How to Design Your Own HF Antenna

No excuses after this ...

Philip Gebhardt VA3ACK
P.O. Box 52
Greenbank ON Canada L0C 1B0
[pgebhardt@compuserve.com]

Not everyone has the opportunity to put up a tower with an HF beam on top. The problem may be space, it could be local law, or it might simply be money. Whatever the reason, if you don't have a tower and a beam, that doesn't mean you are limited to dipoles, single-element verticals, or random-length wires.

You too can have a directive antenna. It's a matter of taking a lesson from commercial broadcasters who use phased verticals as directive antennas. While amateurs have used phased verticals to a limited extent, there are more possibilities than have been fully exploited.

The two configurations which often appear in amateur radio books produce the broadside pattern and the cardioid pattern. These two patterns are shown in **Fig. 1**.

The problem with these patterns is that you might not be able to position the antenna so it radiates in the desired directions. The answer to this problem is to select a configuration which allows you to place the antenna in a convenient location, but will also allow it to radiate in your most frequently used directions.

Fig. 2 shows a bidirectional, endfire pattern, as well as a three-lobe pattern, which allow you to aim your signal in directions that cannot be achieved using the antennas shown in **Fig. 1**. Also shown is a four-lobe pattern, which combines the broadside and endfire ones.

The first step is to determine which configuration will work best for you. **Fig. 3** shows many possibilities using two vertical antennas. For example, with a pair of verticals positioned in a north-south line, you can use a cardioid pattern to aim your signal either north or south. The three-lobe pattern can also yield two directional patterns. You can have the lobes point north/southeast/southwest or south/northwest/northeast. The four-lobe pattern can be aimed north/east/south/west or northeast/southeast/southwest/northwest. As you can see from the chart in **Fig. 3**, there are even variations within these standard patterns.

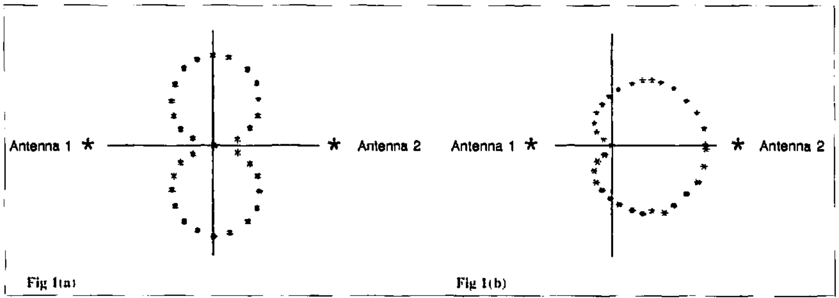


Fig. 1. Array configurations commonly described in amateur radio publications produce the bidirectional, broadside radiation pattern shown at (a) and the unidirectional cardioid radiation pattern shown at (b). The broadside array will transmit and receive in two directions which are perpendicular to the line joining the antennas. The patterns shown here are theoretical patterns in a horizontal plane. In this view, you are looking down on the antennas. The antenna locations are indicated by the asterisks.

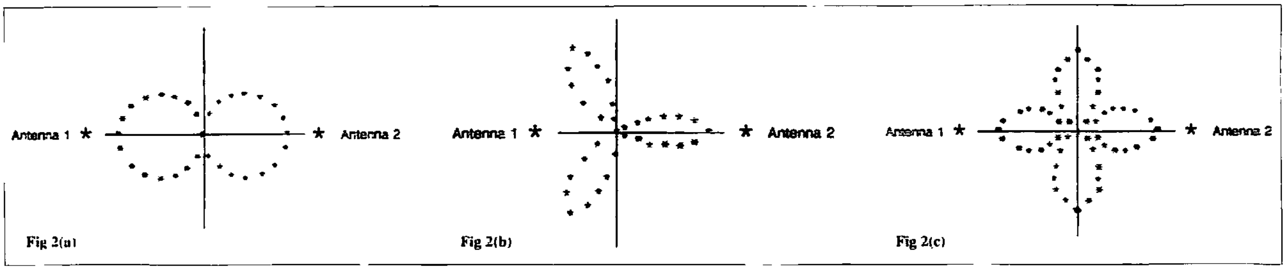


Fig. 2. It is possible to easily produce the bidirectional, endfire pattern shown at (a), the tridirectional (three-lobe) pattern shown at (b) and the quadridirectional (four-lobe) pattern shown at (c). The bidirectional, endfire pattern allows you to transmit and receive in two directions which are in-line with the antennas. The three-lobe pattern provides directions unattainable with either the broadside or endfire arrays, while the four-lobe pattern combines the directional properties of the broadside and endfire arrays.

Of course, if you can align your array in a direction other than north-south, then you have even more flexibility in aiming your signal exactly where you want it to go. With all these possibilities, you can certainly find a pattern which meets your needs.

Since a single-element, omnidirectional vertical antenna will transmit and receive in all directions, you might wonder why anyone would bother with a directional array. The first reason is that the array concentrates the transmitted signal where you want it to go.

Second, in receive mode, the array improves the signal-to-noise ratio. This happens because the array does not respond to noise from all directions as an omnidirectional antenna does.

Third, you can cut down the amount of QRM. For example, (for amateurs on the east coast of North America) an array with a cardioid pattern pointed east will allow you to have QSOs with African stations while reducing QRM from stations to the west.

And last, this is what amateur radio is about—learning and trying new techniques which enhance your enjoyment of the hobby.

Seeing the radiation pattern on paper is one thing. Getting the array to perform the way you want it to is another. Here's how you do it.

First, choose the pattern you want to use from **Fig. 3**. Once you've chosen your pattern, note the spacing of the two antennas in degrees (numbers listed vertically on the left side of the chart). Also note the phasing of the antennas in degrees (numbers listed horizontally at the top of the chart).

You can convert the spacing from degrees to meters (or feet) using **Equation 1**.

s = (degrees/360) x (300/f)
Equation 1a

where
s is the spacing in meters
f is the frequency in MHz

or

s′ = (degrees/360) x (984/f)
Equation 1b

where
s′ is the spacing in feet
f is the frequency in MHz

Converting the phasing distance to meters (or feet) is only slightly more complicated.

Notice in **Fig. 4** that the signal is fed to Antenna 1 and then to Antenna 2. The two antennas are connected together using a phasing line (L1) made of coax. Since radio waves do not propagate as fast through coax as they do through air,

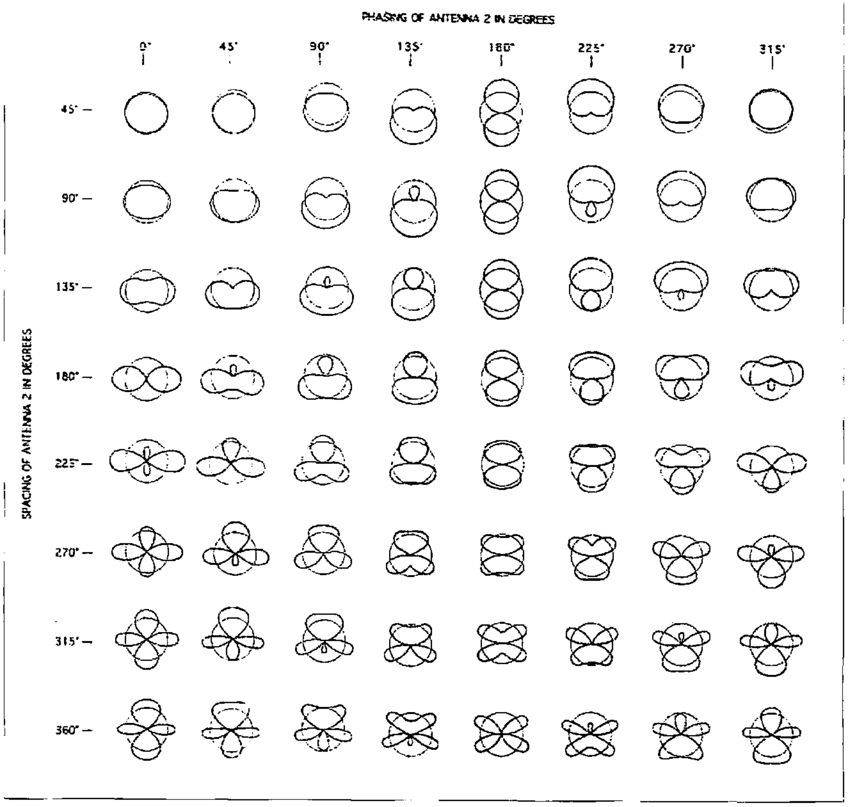


*Fig. 3. This chart shows the many antenna radiation patterns which can be produced using two vertical antennas. Notice that many of the patterns are variations of the patterns shown in **Fig. 1** and **Fig. 2**. As shown in this chart, it is also possible to produce a pentadirectional (five-lobe) radiation pattern. (See the two patterns at the bottom right.) In this chart, Antenna 1 is at the top of each radiation pattern and Antenna 2 is at the bottom.*

you'll have to take the velocity factor (v) of the coax into account. The velocity factor of solid polyethylene-filled coax (standard RG-58 and RG-59) is 0.66. **Equation 2** is used to determine the length of the phasing line.

p = (degrees/360) x (300/f) x v
Equation 2a

where
p is the length of the phasing line in meters
f is the frequency in MHz
v is the velocity factor of the transmission line

or

p′ = (degrees/360) x (984/f) x v
Equation 2b

where
p′ is the length of the phasing line in feet
f is the frequency in MHz
v is the velocity factor of the transmission line

For example, let's assume that you want to erect a bidirectional, endfire array for use on the 10-meter band (28.5 MHz). In **Fig. 3**, Antenna 1 is at the top of each diagram and Antenna 2 is at the bottom. There is an array which meets your needs along the top row, fifth from the left. The spacing (s) between the antennas is 45 degrees and the phasing (p) of Antenna 2 is 180 degrees.

Applying **Equation 1a** gives a spacing (s) of (45/360) x (300/28.5) = 1.32 meters between the two antennas. The length (p) of the coax phasing line (L1) between the antennas according to **Equation 2a** is (180/360) x (300/28.5) x 0.66 = 3.47 meters.

So far so good. But what if you wanted to design a bidirectional, broadside array? Checking **Fig. 3**, you will see that there is one in the left column, fourth from the top. In this case, s = 180 degrees and p = 0 degrees. Applying **Equation 1a** gives a spacing (s) of (180/360) x (300/28.5) = 5.26 meters. The phasing line length (p) is (0/360) x (300/28.5) x 0.66 = 0 meters. Obviously, you can't have two antennas spaced 5.26 meters apart connected by a piece of coax zero meters long.

We need to return to basic transmission line theory to solve this problem. There are two solutions.

For the first solution, we know that as the radio wave travels along the coax, it repeats itself every wavelength (360 degrees). That means that there will be a 0 degree phase difference between the antennas if the coax is 0 degrees long, 360 degrees long, 720 degrees long, 1080 degrees long, or any other whole-number multiple of one wavelength. You could therefore connect the two antennas (using the configuration shown in **Fig. 4**) with a piece of coax 360 degrees long. Using **Equation 2a**, the length (p) is (360/360) x (300/28.5) x 0.66 = 6.95 meters.

The second solution to the problem is to feed the two antennas as shown in **Fig. 5a**. As long as L2 = L3, the signal will arrive at both antennas at the same time. That is, the phase difference between the antennas will be 0 degrees.

Either of these solutions can be used whenever s is greater than p, not just when p = 0 degrees as in the broadside array configuration just described. For example, if s = 270 degrees and p = 90 degrees, then p can be lengthened by 360 degrees to become p = 90 + 360 = 450 degrees. (The feed system used in **Fig. 4**.) Alternatively, the antennas could be fed as shown in **Fig. 5b**, making sure that L2 = L3 and L4 = 90 degrees. In practice, L3 and L4 would be one continuous length of coax.

Although **Fig. 3** shows that you can change the direction of the cardioid pattern (second row, third from the left) where s = 90 degrees and p = 90 degrees to the cardioid pattern (second row, seventh from the left) where s = 90 degrees and p = 270 degrees, there is a more practical solution to reversing the direction. You can simply switch the direction in which you feed the antennas.

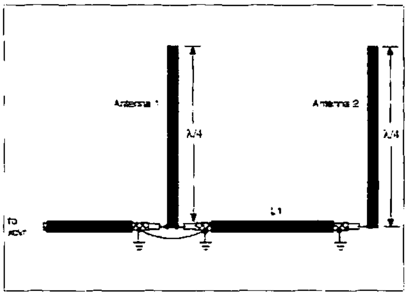


*Fig. 4. Two quarter-wave verticals are needed to produce the radiation patterns shown in **Fig. 3**. In the configuration shown here, your transceiver feeds one antenna (Antenna 1) as normal. However, a second piece of coax then connects the second antenna (Antenna 2) to the first antenna. Which pattern is produced depends on the spacing of the antennas and on the length of the phasing line (L1) connecting the two antennas. Not shown in this diagram are the ground radials used with quarter-wave verticals. The coax shield would be connected to the antenna radial system.*

Fig. 6 illustrates this. The arrow in the cube shows the direction of maximum radiation from the array. At (a), the signal will be transmitted in a direction in line with the antennas and from Antenna 1 toward Antenna 2. At (b), the signal direction has been reversed.

The flexibility of the array can be increased very easily. While it is not practical to adjust the spacing between the antennas, it is easy to interchange phasing lines.

For example, you might space the two antennas 225 degrees apart. When the phase between the antennas is 0 degrees, you have a bidirectional, broadside pattern.

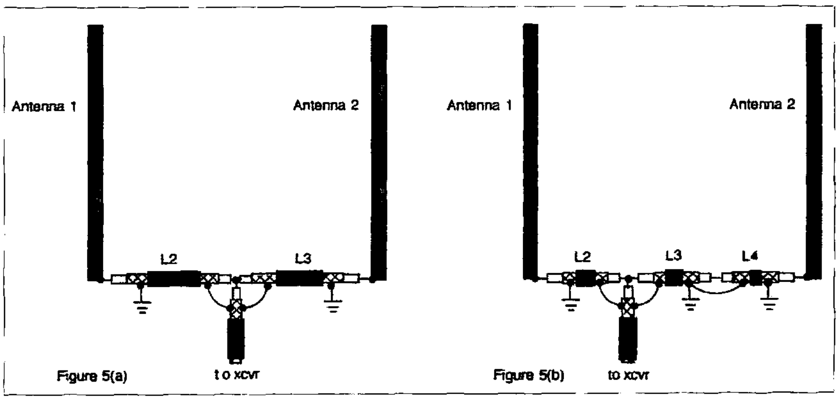


Fig. 5. Sometimes it is more convenient or practical to feed the antennas as shown here. The feed arrangements are explained in the text.

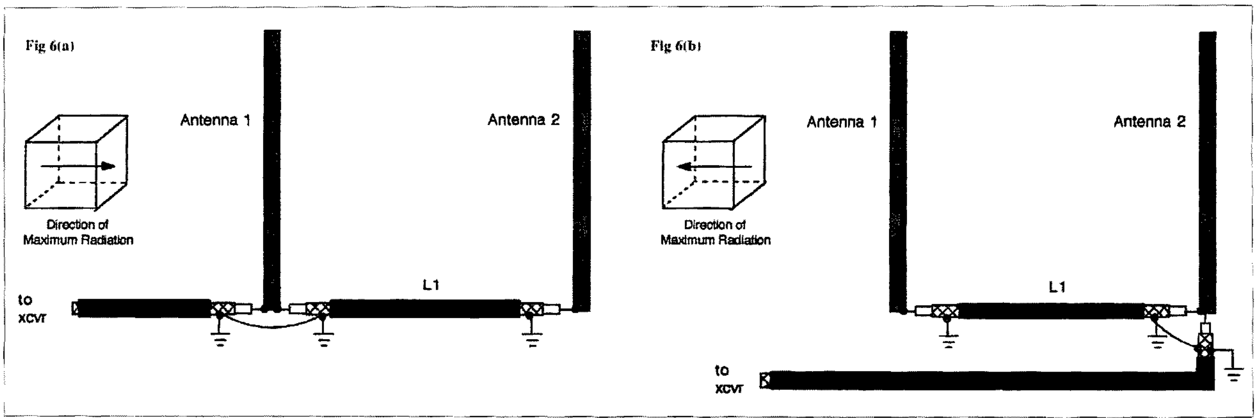


Fig. 6. It is possible to reverse the array's direction of radiation by altering the length of the phasing line (L1). This approach, however, requires two phasing lines—one for each direction. It is possible to reverse the direction the signal travels by feeding the array in the opposite direction. For example, in the array shown at (a), the transceiver feeds Antenna 1 and the phasing line (L1) then feeds the signal to Antenna 2. In this case, the signal radiates in a direction from Antenna 1 toward Antenna 2 as shown by the arrow in the cube. The array at (b) uses all the same elements. However, the transceiver feeds Antenna 2 and the phasing line then feeds the signal to Antenna 1. This array will radiate in a direction from Antenna 2 toward Antenna 1. This is a good reason to use coax connectors at the base of the antennas rather than connecting the coax lines permanently to them.

At 45 degrees, you have a three-lobe pattern. This pattern is altered by increasing the phasing to 90 degrees. For 180 degrees phasing, you have a bidirectional, endfire pattern. In addition, the direction of either three-lobe pattern can be reversed by changing which antenna is connected to the main transmission line.

Until now, I've assumed that the directional array would be a single-band antenna. Not so. For example, by using a pair of trap verticals, you could use the array on the 20-, 15-, and 10-meter bands. If you chose a spacing (s) of 360 degrees on 10 meters, then the same physical spacing would look like 270 degrees on 15 meters and 180 degrees on 20 meters. You could even use the same phasing line on all three bands. **Fig. 7a** shows one possible array.

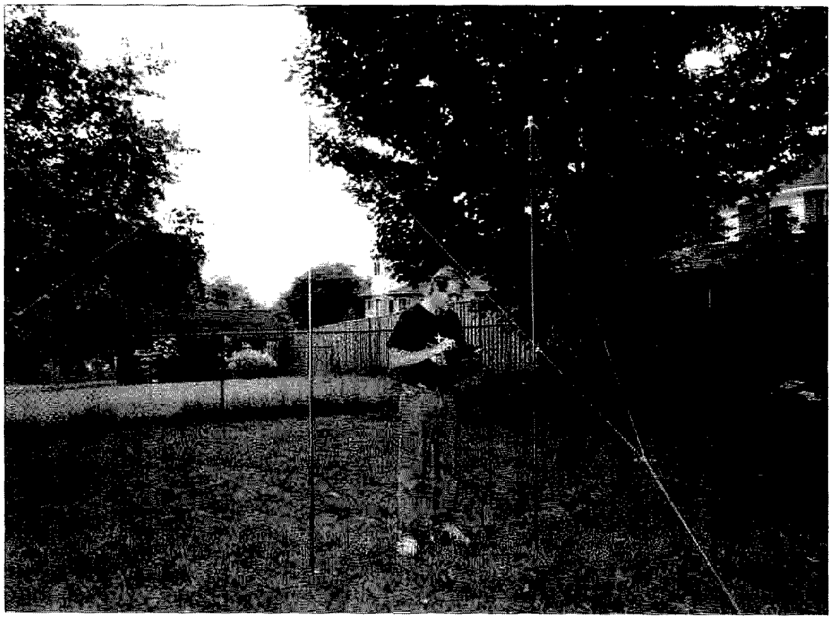


Photo A. *As shown by the author, directive antennas do not need much space. The two quarter-wave verticals used in this array for the 10-meter band are spaced 1/8-wavelength apart. The array produces a unidirectional cardioid pattern, one of sixty-four possible ones that can be produced using only two antennas and the information in this article. This single-band array can be turned into a multiband array by using trap verticals.*

Assume the 10-meter pattern selected sets s = 360 degrees and p = 0 degrees. The 10.52 m spacing (s) represents 360 degrees on 10 meters and the phase line length (p) is 720 degrees or 13.89 m. (A 720 degrees phase line is necessary because the two antennas cannot be connected using a 0 degree phase line. A 360 degree phase line is still too short to connect the two antennas, so the next length to give a 0 degree phase difference between the two antennas is 720 degrees.)

On 10 meters, this array will produce the four-lobe pattern shown in **Fig. 7b**. On 15 meters, the antennas appear to be spaced only 270 degrees apart and the phasing line now appears to be 540 degrees long (giving a phasing difference between antennas of 540-360 = 180 degrees). This produces the radiation pattern shown in **Fig. 7c**.

On 20 meters, the spacing is 180 degrees and the phasing line is 360 degrees long (giving a phasing difference of 0 degrees). The radiation pattern on 20 meters is shown in **Fig. 7d**.

There are many other possibilities. Keeping the 10.52 m spacing, the phasing could be set for 180 degrees on 10 meters. The phasing line would then be 135 degrees on 15 meters and 90 degrees on 20 meters. This would give three different radiation patterns from the ones shown in **Figs. 7b**, **7c**, and **7d**.

Alternatively, you could select a different spacing. For example, if the spacing (s) were fixed at 5.26 m, this would be 180

degrees on 10 meters, 135 degrees on 15 meters and 90 degrees on 20 meters. A phasing line 360 degrees long on 10 meters would appear to be 270 degrees long on 15 meters and 180 degrees long on 20 meters. This combination produces a different set of radiation patterns to choose from.

The feed system shown in **Fig. 7a** is identical to the system used in **Fig. 4.** It is also possible to use the feed system shown in **Fig. 5a**. What makes this configuration interesting in a multiband array is that the phasing is independent of frequency. Since L2 = L3, the signals will always arrive at the two antennas in phase (that is, the phase difference between the antennas will be 0 degrees).

Compare this feed method to the first multiband example above (s = 360 degrees, p = 0 degrees on 10 meters). Using the feed system of **Fig. 5a**, if s = 360 degrees on 10 meters, then s = 270 degrees on 15 meters and s = 180 degrees on 20 meters. So far, this is the same situation as before. However, in this case, p = 0 degrees on all three bands. So, while the radiation pattern on 10 meters will be the same with either feed system, on both 15 and 20 meters a different radiation pattern can be obtained depending on whether you choose to use the feed method of **Fig. 4** or the method shown in **Fig. 5a**.

A practical array

Here's how I built my directional array.

I wanted to try the array on the 10-meter band. Living in Canada, I decided that my best opportunities for DXing would be stations in the southern U.S., the Caribbean, Central America, and South America. Consequently, I decided on a cardioid radiation pattern. Checking the chart in **Fig. 3**, I selected the pattern for which s = 45 degrees and p = 135 degrees.

The necessary spacing (s) was (45/360) x (300/28.3) = 1.32 meters. The phasing line length (p) was (135/360) x (300/28.3) x 0.66 = 2.60 meters.

The array is shown in **Fig. 8a**.

Two practical considerations arose. First, a quarter-wavelength vertical antenna does not match 53-ohm coax (RG-58). If the phasing line is 180 degrees or 360 degrees long, that is not a problem. In either of these cases, the impedance at the load (antenna) end of the coax will appear at the input end of the coax. That is, the impedance of Antenna 2 will appear in parallel with Antenna 1 and the main transmission line from the transceiver will "see" two antennas with equal impedance.

Other lengths of phasing line (45 degrees, 90 degrees, 135 degrees, 270 degrees, 225 degrees, 270 degrees or 315 degrees) will effect an impedance transformation. In this case, the impedance of Antenna 2 will be transformed to a different value. As a result, the main transmission line will be connected to two antennas with different impedances. Consequently, the power will not be distributed equally between the antennas. The radiation pattern will then be distorted.

While you can accept this distortion and have a workable array, I chose to alter the phasing line impedance. I did that by running two 135 degree sections of RG-58 (53 ohms) in parallel to produce a transmission line with a characteristic impedance of 26.5 ohms. (See **Fig. 8b**.) By doing this, I avoided the impedance transformation.

The two 25-ohm antennas in parallel will produce an even lower impedance

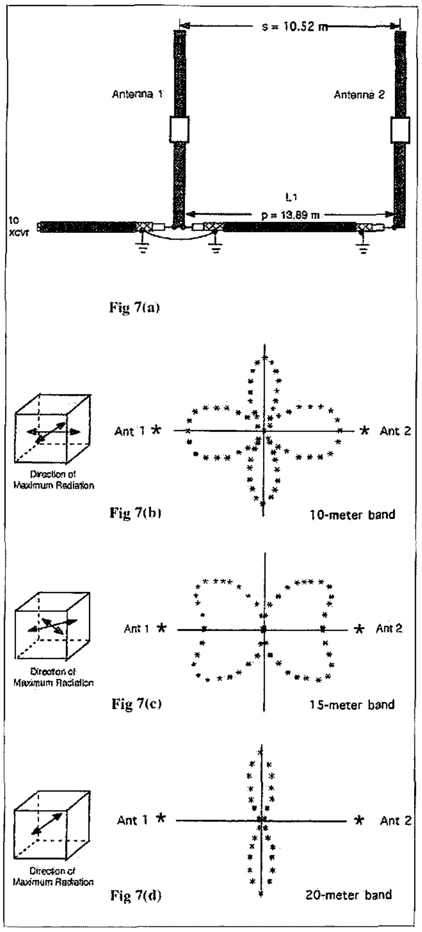


Fig. 7. While a phased array is often thought of as being a single-band antenna, it is possible to use an array on several bands—without changing the antenna spacing (s) or the phasing line length (p). The basic configuration for an array using trap verticals designed for 10-, 15-, and 20-meter use is shown at (a). The other diagrams show how the radiation pattern changes as you switch bands.

Photo B. Each antenna is supported on a glass insulator which is an inverted glass jar partially sunk into the ground. The 296 ml (10 oz.) jam jar shown here has a concave bottom that helps keep the antenna in place. The jar fits inside a 796 g (28 oz.) tin can which is sunk into the ground. The can holds the glass jar in place and provides an initial grounding point for the coax and the antenna. Radial wires are connected to the can.

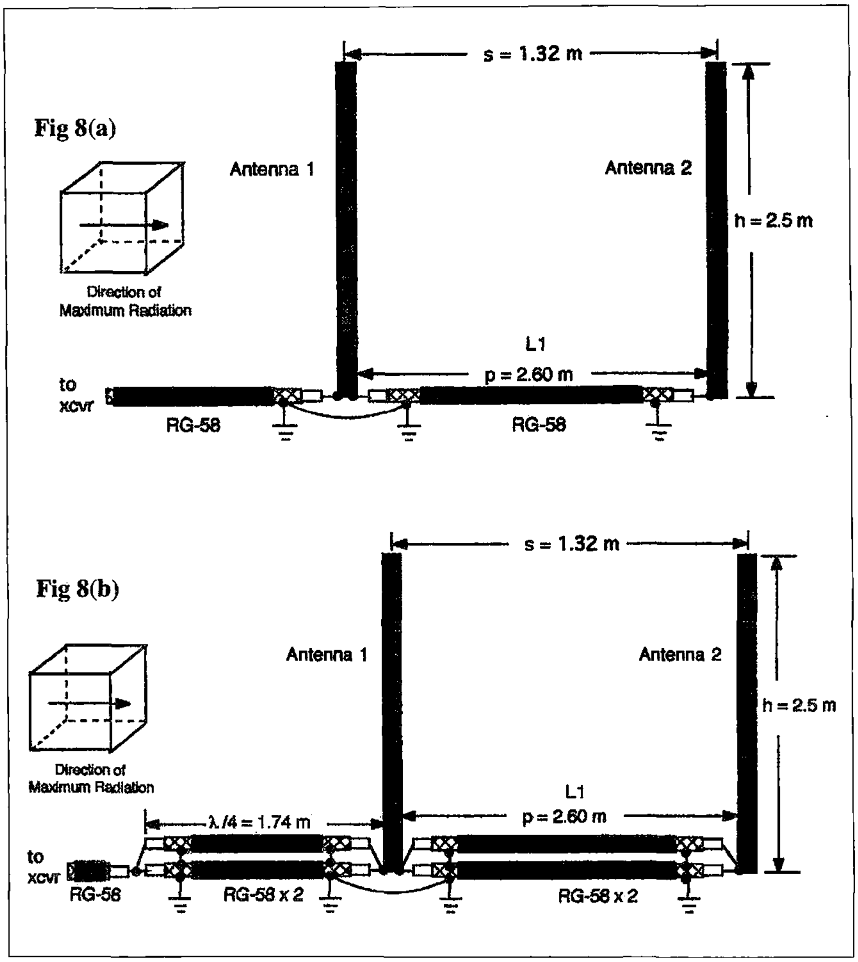


*Fig. 8. Shown at (a) is an array based on the information in **Fig. 3** to produce a unidirectional, cardioid radiation pattern. From my QTH in southern Canada, the array allows me to beam my signal to the U.S., the Caribbean, and South America. At (b) is shown a modified feed system to accommodate the low impedance to the verticals. The phasing line (L1) is made of two parallel sections of RG-58 to produce a transmission line with a characteristic impedance of 26.5 ohms. A quarter-wave linear transformer (Q section) is added between the main transmission line from the transceiver and the array. The Q section transforms the low impedance of the array to approximately 50 ohms. Like the phasing line, the Q section is made of two sections of RG-58 in parallel.*

as seen by the main transmission line. I corrected this by putting a quarter-wave transformer (Q section) between the main transmission line and the array as shown in **Fig. 8b**.

Let's assume the impedance of Antenna 1 and Antenna 2 in parallel is 12.5 ohms. The impedance at the transmitter end of the Q section can be calculated using **Equation 3**.

$$Z_o = \sqrt{(Z_r \times Z_i)}$$

so,

$$Z_i = Z_o^2/Z_r$$

Equation 3

where

Z_i is the impedance at the transmitter end of the Q section in ohms

Z_o is the characteristic impedance of the Q section in ohms

Z_r is the antenna impedance in ohms

If Z_o = 26.5 ohms (2 parallel sections of RG-58) and Z_r = 12.5 ohms, then Z_i = $26.5^2/12.5$ = 56 ohms. As a result, the main transmission line from the transceiver would "see" a load with an impedance of 56 ohms—almost a perfect match.

Equation 4 is used to calculate the length of the Q section.

$$\lambda/4 = (75/f) \times v$$

Equation 4a

where

λ/4 is the length of the Q section in meters

f is the frequency in MHz

v is the velocity factor of the transmission line

$$\lambda'/4 = (246/f) \times v$$

Equation 4b

where

λ'/4 is the length of the Q section in feet

f is the frequency in MHz

v is the velocity factor of the transmission line

The length of the Q section for my 10-meter array was 1.74 m.

The feed system shown in **Fig. 8b** can be used to advantage with any of the arrays described in this article. If you apply this method to a multiband array, remember that while you need not change the phasing line (LI) when you change bands, you will need to construct a separate Q section for each band.

So now that you know how to aim your signal, why settle for a dipole strung between two trees when you can send your signal wherever you want? ■

Readin', Writin', and Robotin'

Is your *high school entered in FIRST?*

Michael D. Gray
1680 Cooley Lake Road
Milford MI 48381

The folks at FIRST (*F*or *I*nspiration and *R*ecognition of *S*cience and *T*echnology) have devised an exciting way to expose high school kids to engineering and technology. The program is the brainchild of Dean Kamen, a physicist, engineer, and entrepreneur from New Hampshire. His personal goal, and that of FIRST, is to show high school students how much fun engineering can be, encouraging them to pursue careers in technology.

Each year, Mr. Kamen and Professor Woodie Flowers, Director of MIT's New Products Program, create a game in which teams compete with radio-controlled robots. The game in 1997 was called "Toroid Terror" and the goal was to place colored inner tubes on a rotating eight-foot goal. On the surface, that may sound a little dull—but when three robots are in play at once, all competing against the clock and cheered on by a really excited crowd, you have the makings of a pretty wild time. Teams are encouraged to create stickers, buttons (for trading with other teams), tee shirts, hats, noisemakers, and whatever else might possibly contribute to the team identity.

The students learn something about mechanical, electrical, electromechanical, pneumatic, and control systems in their quest for the perfect machine for the game. Students and engineering sponsors form cohesive teams very quickly. The teams have only six weeks to construct a machine of their own design from a box of parts supplied by FIRST. There is a tremendous amount of design latitude afforded by the variety of parts, as long as weight and dimensional restrictions aren't violated.

The fun doesn't end with tubes, gears, motors, switches, sheets, shafts, wire, and data radios. For the first time, in 1997 the controller supplied by FIRST was programmable! The language is a dialect of BASIC which the students can learn without much difficulty. The programming software runs on any IBM-compatible. FIRST supplies a default program

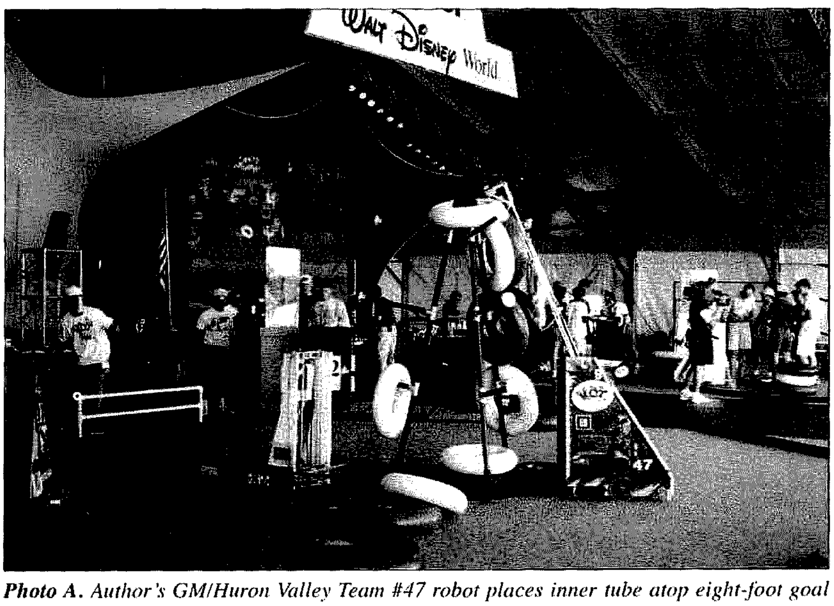


***Photo A.** Author's GM/Huron Valley Team #47 robot places inner tube atop eight-foot goal for a double score.*

which functions perfectly well for those who don't want to write their own code. The example code is well annotated and easy to follow, so most teams feel confident in writing custom functions for their controllers. Some were very creative with their programming. At least one team used position sensors on rotating members for feedback to the controller.

Events

Regional competitions are held across the US beginning in March. All the teams learn a lot about strategy, which prepares them for the finals at EPCOT Center in mid-April. Both events are open to the public. FIRST could not have picked a better place than EPCOT for the three-day event. Disney and FIRST are about technology, fun, and the rewards of hard work. Students, teachers, technologists, and engineers learn from each other and have a great time doing it. All the teams show gracious sportsmanship, and some will even share tools, parts, and talent to help get a competitor's machine battle-ready.

This year (1997) was the rookie year for the General Motors Milford (MI) Proving Ground and Huron Valley (MI) Schools team. The team had a late start and worked several long weekends to catch up. The animation crew even worked all night to finish the video entry on time! The team placed 27th of 113 teams, and took one of two Rookie All-Star awards.

Awards

The Honeywell Leadership in Control Award goes to the team with the most unique control system. The team with the most robust design gets the Motorola Quality Award. Johnson & Johnson offers a Sportsmanship Award. Chrysler shows how much they value team efforts by presenting a Team Spirit Award. The Procter & Gamble Creativity Award is very broad, encompassing design and play criteria. Other awards are: Best Play of the Day, Number One Seed, Outstanding Defense, Most Photogenic, Best Offensive Round, Featherweight in the Finals, and Rookie All-Star. A highly qualified body of judges determines which teams receive awards.

Of the 17 awards possible, the Chairman's Award is the most prestigious. This award has nothing to do with winning the game. It has to do with student involvement, teamwork, creativity, and the level of cooperation between school and sponsor. The Founder's Award is presented by Dean Kamen to the person or organization which best promotes the goals of FIRST. The Autodesk Award goes to the team whose computer animation presents the best creative design solutions for the competition. The Woodie Flowers Award goes to an individual who excels in teaching math, science, engineering, and creative design. All the teams have an opportunity to vote on which team will receive the Worcester Polytechnic Institute Design Innovation Scholarship.

Want to get involved?

In these days of cellular phones and notebook computers, it's pretty hard to get kids interested in amateur radio as a vehicle into science and engineering. They need a really exciting project to light 'em up and get their scientific juices working so that amateur radio can be seen as the neat technical hobby it really is instead of an outmoded waste of time.

Would you like to be a sponsor or participant in the FIRST robotics competition? Every member of our team will assure you that the hours are long, but the rewards are great and it's worth every minute! 73

Our Friend Pythagoras

Pop quiz: Who can state the Pythagorean Theorem?

Peter A. Bergman NØBLX
3517 Estate Dr. SW
Brainerd MN 56401

Because I am an amateur radio operator as well as a member of the Civil Air Patrol, I am often involved in public service and emergency communications. Frequently during these events, we have need for an antenna support more reliable than motor vehicles or Mother Nature.

With this in mind, I started experimenting to develop the best means for setting up—and keeping up—the portable PVC masts we often use. But the method had to be easy for one person to implement, since helpers aren't always there when they'd be most helpful.

There is nothing magical about what I am about to explain. Those of you using a similar method know that it can save a lot of random running around.

It is common practice when erecting a mast to start by attaching the guys and halyard and then anchoring the base to some kind of pivot. After that you pick up the top of the mast, lift it over your head and start walking toward the pivot. If you can. Meanwhile, two or three assistants fan out with the guys to keep the mast from falling beyond center. Finally, the guy anchors are placed and the business of adjusting the lengths to hold the mast vertical starts. Then the antenna is hoisted on the halyard.

There's got to be ...

If you would like to try an easier way, here it is (see **Fig. 1**). We are going to replace Brownian movement with some planning and just a bit of engineering.

1. Select the location for the antenna's feedpoint. This will probably be near a spot where you can set up your comm station. Mark that spot with a small stake. Back off a reasonable distance, set up your camp stove and start some coffee.

2. If you are installing a dipole, unroll it and lay it in the desired orientation, with the center insulator at the stake you drove earlier. Attach and unroll the feedline.

3. Place the side guy line stakes for the center support mast. Measure this distance with a piece of cord the same length as the mast, and either drive the stakes now or mark their positions with a puff of builders' chalk. The cord is stored by wrapping it around the chalk bottle. The stake positions can be "eyeballed" or you purists can be more precise by checking the "constructions" chapter of any basic geometry text for information on constructing a perpendicular bisector to a line.

4. At each end insulator, drive another stake.

5. Using the cord and chalk, "puff" a circle around each end stake with a radius equal to the height of the mast. You don't need to use a lot of chalk—just enough to tell where the circle is (see **Fig. 2**).

6. At the point where the antenna wire crosses each circle, drive a guy line stake.

7. On the circle you have drawn around each end of the dipole, eyeball a point on the side opposite from the antenna and measure one radius each way around the circle. Place anchors at those points.

8. Attaching the precut guy lines is when the plan starts to come together. Remember the Pythagorean Theorem? $A^2 + B^2 = C^2$. What it really says is that the square of the height of the attachment point on the mast plus the square of the distance from the mast to the anchor stake equals the square of the length of the guy line. So, if the mast is 30 feet high and the anchor stake is 30 feet away, then the length of the guy line equals the square root of 900 plus 900, which equals 42.5 feet plus a little for good luck.

A 30-foot mast made of three-inch schedule 40 PVC seems to work pretty well with just top guys. If you plan to use more height or smaller diameter pipe, plan on more guy lines.

9. Attach the antenna insulators to the masts.

10. Go to one end of the antenna and while facing the bottom end of the mast, pick up the top and place it on your shoulder with the antenna and guys hanging behind you. The whole works is going to look pretty sloppy and floppy—especially if you are using one-and-a-half-inch pipe—but have faith and start pulling the base toward you. As you do so, the top will rise and the base will move toward

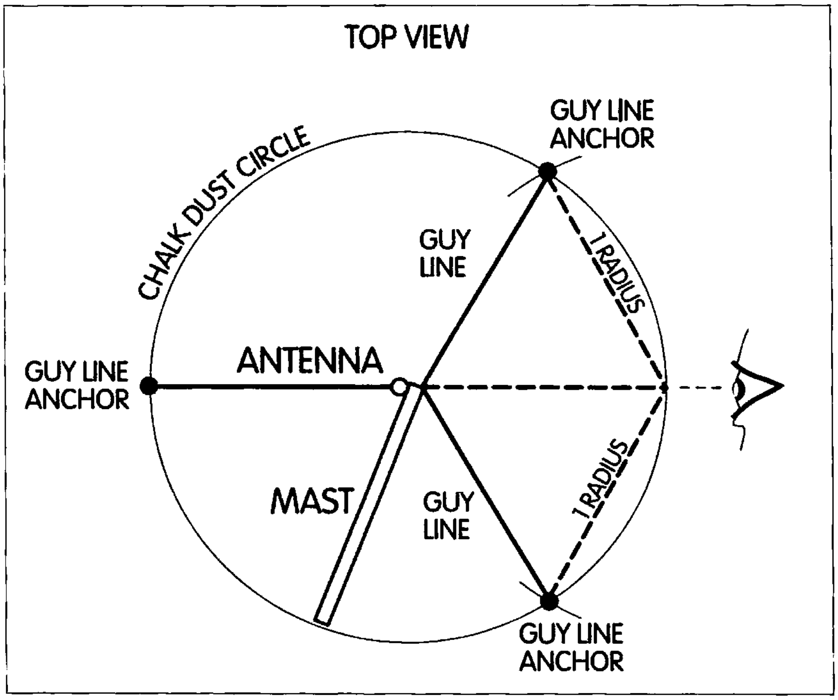


Fig. 1. Single mast detail. If everything is measured and cut beforehand, an antenna can be erected quickly in the field.

the center of the marked circle. Instead of you trying to lift the mast and the guy lines, they will work for you and make the whole process quick and easy.

11. Repeat Step 10 at the center mast and the other end of the dipole.

12. Do whatever fine tuning is required to accommodate irregularities in the terrain.

The coffee should be ready about now, so have a cup while you wait for the fellows with the rigs to show up.

Obviously, this method can be used to erect a single mast for an inverted vee or a lightweight VHF/UHF antenna. If the surface you are working on is too hard to accept stakes or too soft to hold them, you will have to do something else—replace the stakes with sandbags or perhaps buckets filled with rocks, or water, or whatever.

Give this method some consideration, try it at home, or perhaps at a club or unit meeting. It's fun, and it works!

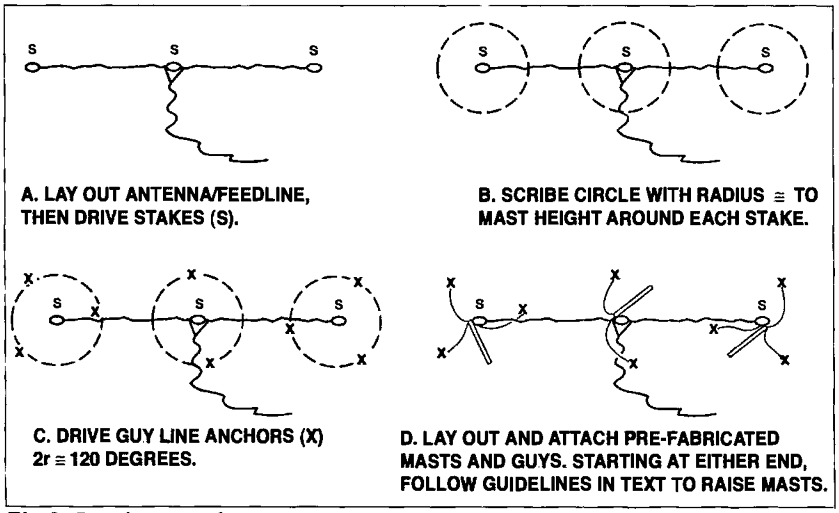


Fig. 2. Complete procedure.

Electronic Construction from A to Z

Everything you wanted to know about building stuff but were afraid to ask.

Marshall G. Emm AAØXI/VK5FN
2460 S. Moline Way
Aurora CO 80014
[aaØxi@mtechnologies.com]

As the doctor said to the patient, "I've got good news and bad news." The bad news is all around us—increasing prices, a decreasing skills base, no more Heathkits™ ... and if you want more, just pick up a newspaper. The good news is that you can still build a lot of useful ham radio equipment and you don't have to be an electrical engineer to do it. All it takes is the right tools, knowledge of a few "tricks of the trade," and the will to succeed. Oh, yeah—a bit of patience helps, too! We're going to try to cover the whole topic here in enough detail for you to pick up a soldering iron and get to work on a real project.

First we'll talk about the basics: things like tool selection and soldering; then we'll move on to middle-to-advanced techniques; and finally troubleshooting the finished project and installing it in an enclosure. Along the way we'll build something useful, I promise. You're going to discover that building is rewarding, educational, and fun!

Why build something when you can buy it?

There are several reasons for building (even if you only need one).

•Creativity. You have the pleasure and pride of doing something with your own hands. In fact, it's so rewarding that many of us will build a device even when building it is more expensive than buying it.

•Economy. Building is often less expensive than buying off the shelf.

•Availability. Sometimes what you want is simply not available, or available only as a kit.

•Knowledge. If you build it, you will probably be able to fix it if it breaks, or modify it. You will also gain a better understanding of how that particular type of equipment actually works.

These four factors will influence your decision to build something, and whether to buy a kit or start from scratch. The project that we will build together can be purchased as a kit, or built from scratch. Virtually everything in this series will relate equally to either approach.

A disclaimer, of sorts

I'm in the business. My company, Milestone Technologies, sells some of the tools that I am going to recommend and also the kit that we're going to do as a project. I'd hate to think that you would think I'm writing this series to sell stuff, so I will make a point of providing an alternate source for each of those items that I sell. Call me old-fashioned, but I'm tired of projects in other magazines which are thinly disguised ads for the author's own products. In the case of programmed devices, that's OK

Basic Hand Tools			
Item	Supplier	Price, $US (subject to change)	Part Number
Long-nose pliers	RS	3.99	64-1844
Cutting pliers	RS	3.99	64-1833
Screwdriver, reversible	RS	2.69	64-1950
Jeweler's driver combo set	RS	4.79	64-1959
Hobby knife	RS	1.49	64-1805
Magnifying glass *or* Jeweler's loupes (set of 3)	RS MT	5.99 7.95	63-848 35450
Multimeter, 8-range analog *or* Multimeter, 14-range analog	RS MT	14.99 9.95	22-218 30812
Clip lead set (10) mini alligator	RS	3.99	278-1156
Sheet-metal nibbling tools *or* Heavy-duty nibbling tool	RS MT	10.99 9.95	64-823 00539
Basic Soldering Tools			
15 W Soldering iron	RS	7.99	64-2051
Replacement tip for above	RS	0.99	64-2052
Solder, 60/40 rosin core .032" 2.5 oz.	RS	3.79	64-005
Solder wicking braid	RS	2.29	64-2090
RS - Radio Shack MT - Milestone Technologies			

Table 1. *Tools for basic kit-building.*

up to a point (almost all integrated circuits have proprietary content), but in a recent issue of a major magazine (not *73*) there were three projects, and not one of them could be built without buying something from the author! Making some of these things available to you from Milestone Technologies is a service which you are free to decline.

A poor workman blames his tools

A lousy violinist playing a Stradivarius is going to sound like someone scraping a horse's tail across a cat's gut. A great violinist can make a cigar-box violin sound like a Strad. Or to put it in more familiar terms, an unskilled ham will have trouble making contacts with a $3000 rig and a beam on a 100-foot tower, while a skilled operator can work DXCC on a homemade QRP rig with a dipole. The point here is that skill is more important than tools: Investing hundreds of dollars in tools and test equipment is not going to make you a good builder or technician. The value of your tool armory will increase as time goes by, but the basic tools for electronic construction are relatively inexpensive, and all of them are available at your local radio parts store and by mail order.

Let's talk about two basic tool kits for electronic construction: hand tools and soldering tools. The hand tools are really simple at entry level but even basic soldering tools start to get into areas of complexity, so you may want to read the section on soldering before deciding what to buy. The recommendations are summarized in **Table 1**, which shows suppliers' part numbers for Radio Shack (RS) and Milestone Technologies (MT).

Hand tools:

A pair of long-nose pliers, for bending the leads on components.

A pair of cutting pliers—what you are looking for are "flush-cutting" pliers rather than the traditional "dikes" or "diagonal-cutting pliers." These are used for cutting wire and trimming leads on the soldered side of a circuit board, and "dikes" just won't get close enough to the board.

You will need two large screwdrivers; one with a straight tip for slotted screws; the other with a Phillips™ head; and a set of miniature drivers. The mini drivers (often called "jeweler's screwdrivers") can be bought as separate sets for straight and Phillips, or as a combination set.

Hobby knife—for example, a Stanley™ knife, with a razor-sharp blade, for stripping wires and trimming things.

Multimeter for checking voltages, resistances, continuity, and current. A digital multimeter with an "audible continuity feature" is great, but you can get by with an inexpensive VOM (Volt-Ohm-Milliammeter).

Magnifier for examining circuit board traces and solder connections. If you can, you should solder under magnification, using a magnifying work lamp, but you can start with a hand magnifier or loupe.

Clip leads (wires with alligator clips on the ends for making temporary connections).

Sheet Metal Nibbling Tool for making large or odd-shaped openings in sheet metal—for example, aluminum panels for mounting controls. Much faster and easier than filing.

Soldering tools:

A soldering iron. That's so easy to say, but there's much more to it! We're talking molten metal here, in close proximity to delicate electronic components. When

you're working on a printed circuit board you need to apply a precise amount of heat for a reasonably precise amount of time to a *very* precise area! Your beginner's tool kit should include a 15-30 watt soldering pencil with a fine chisel tip and at least one spare tip. Ultimately you may want to invest in a "soldering station," but please buy one with temperature control rather than wattage control (see the section on soldering for details). You will need a much heavier iron (100+ watts) if you are going to work with coax connectors, but don't try to use it on a circuit board!

It's traditional to start out with a caution that you must use rosin core solder, never acid core solder, but in practice acid core solder is so hard to *find* that the warning is almost superfluous. There are three factors to consider: metallic content; type of flux (core); and diameter; and the result is a huge range of solders available on the market. For now, let's leave it with a recommendation that you start with 60/40 (60% tin, 40% lead) rosin-core solder with a diameter of around .03 inch. This will be fine for almost any kit or project and there's no point in departing from it until you have a particular reason to do so.

Solder wicking braid—you will make mistakes. I do … everyone does. Besides, there will be times when you want to remove a component for testing, or to substitute a different value. The only practical way to unsolder a connection is with solder wicking braid. You'll see solder suckers and other "one-hand" desoldering devices, but if they are any help it all, it is because you used *way* too much solder on the connection to start with!

Your "work bench" is important, too, although it doesn't have to be elaborate. A kitchen table or desk will do. Things to consider are light, ventilation, and access to mains power and ground. When it comes to light, you simply can't have too much. Fluorescent light is best for electronics work because it is "whiter" than incandescent light. Ventilation is particularly important when you are soldering, because the fumes from the rosin can be irritating or even harmful over time. You will need mains power for your soldering iron, and you will often need to connect things to a good electrical ground (the center screw in the AC outlet will do).

Other than that, all you need to worry about is a reasonable amount of clear space, and places for tools and components. If you are using a space that has other purposes (i.e., your kitchen table) it's easy enough to keep your tools and components in trays so they can be easily put aside when you are not working.

Soldering 101

Entire magazine articles, even books, have been written about soldering. So how can I hope to teach you to solder with a few paragraphs and illustrations? Easy. Soldering is not difficult, and the basics are easily within your grasp if you have the right soldering iron, the right solder, and a little bit of practice.

Practice is important, so if you are new to soldering, please take the time to do some before we start on the project! You can practice on any old components and a bit of scrap circuit board material or skip ahead to unsoldering, remove a couple of components from a junk circuit board and resolder them. Kit suppliers will tell you that 90% of all problems in kit building are a result of poor soldering. How can that be, if soldering is not difficult?

Simple ... carelessness and ignorance. We'll fix the ignorance problem right now—carelessness is up to you.

Soldering is a process of amalgamating metals to provide a good electrical connection. Solder is a mixture (alloy) of two or more metals with a relatively low melting point, that will flow onto the surface of other metals creating a low-resistance electrical connection. Ordinary solder is not very strong, and you should never rely on solder alone to hold components together physically. The mechanical connection should be secure before you apply solder, and the parts should not be able to move in relation to each other. The flux is vaporized by the heat of the iron and the vapors will clean the surfaces of any oxidation (often invisible to the naked eye), allowing the solder to flow freely onto the metal surfaces.

The purpose of the soldering iron is to transfer heat into the work to be soldered; the solder should melt upon contact with the work. The iron must be at the correct temperature to do this, and some elementary principles of thermodynamics are involved here. Fortunately, we don't have to worry about the details too much—a 15–30 W iron will heat up to an appropriate temperature and won't get too hot under ordinary circumstances. But let's look at the basics anyhow, because they will help you to understand what is going on, and also influence your decision to buy a temperature-controlled soldering iron later!

The wattage of an iron is a measure of the power that is used to generate heat. Your soldering pencil is always running at that level of power consumption, and it is always generating heat. The tip has a specific mass which can absorb heat. As long as power is supplied, it will continue to get hotter until it reaches equilibrium at its maximum temperature. Heat will be conducted away from it (into the surrounding air) as quickly as it is generated by the applied power. Heat will transfer out of the tip more quickly when it is in contact with the work—the rate at which that occurs will depend on the size and shape of the tip, the amount of its surface that is in contact with the work, and the nature of the work (how quickly heat is conducted away from the point of contact). When your soldering pencil is sitting idle it very definitely gets much hotter than required for soldering, but its heat drops almost instantaneously when you apply it to the work, and the applied power sustains the working temperature. When it's idle, though, at higher temperatures, its surface is much more susceptible to corrosion. So turn it off when you are not actually soldering (for more than five minutes or so). Otherwise, you can expect to replace or refinish the tip fairly frequently. Leaving it on overnight *once* will ruin the tip. Once the tip has been overheated and cannot be tinned (see below) you can file or grind it down and start over, but it is usually a lot easier just to replace it.

All else being equal, the wattage of an iron is a poor indicator of its performance because its main effect is in how quickly the iron will heat up to its maximum equilibrium temperature, or how fast it will create new heat for transfer into the work—not necessarily how hot that temperature will be! That's why the best irons, if somewhat more expensive, are temperature-controlled and not "variable output." I finally worked that out for myself after going through perhaps a hundred soldering iron tips.

From this point on, I'll be talking about soldering components onto a printed circuit board, but the principles apply to other soldering such as wire connections to controls.

Allow the iron to heat until solder flows freely on the tip, "tinning" it. This means there should be a thin, shiny coating of solder on the working surface of the tip—it should not "ball up" and drop off. Apply a small amount of solder to the tip and then wipe it off quickly with a soft cloth or a damp sponge. You can probably do three or four joints in immediate succession without having to repeat this tinning process, but if you stop soldering to place components on the board you will need to repeat it.

Here are the steps in soldering a component into a circuit board.

1. Inspect the board and the component leads, and make sure they are clean. Older components may be oxidized and require cleaning (use fine sandpaper, or scrape with the edge of your hobby knife). Most circuit boards do not require cleaning before use, but it can't hurt. Wash the board with soap and water, and use a mild abrasive (Scotch™ scouring pad, for example) or metal polish only if absolutely necessary. The surface of the tracks should be shiny and free of smudges and fingerprints. Some builders (and kit suppliers) will recommend cleaning a board before use and completing it in one session, but I have never found this to be necessary—that's why there's flux in the solder!

2. Mechanically install the component. Use your long-nose pliers to bend the component's leads so that they will go straight into the holes in the board. If the spacing permits, hold the lead with the pliers and bend the end of the lead against the jaws of the pliers. Otherwise, watch what you are doing and make sure you are not exerting excessive pulling force on the lead—you can easily ruin a diode or inductor by pulling on the lead. Check the value before you insert it in the board. If it is a polarized component such as an electrolytic capacitor, double check the orientation. If the component isn't polarized (for example, a resistor or ceramic capacitor) then it doesn't matter which way it goes, but it's a good idea to mount it so that you will be able to read

the value later. I usually put resistors in with the tolerance band to the right or bottom depending on how the resistor is mounted, and capacitors with the value facing me or to the right (unless they are very close to a larger component, in which case I turn them around). The aim is simply to make it easy to see and verify all of the component values after the board is complete. Before you solder it, *recheck* the value, the orientation, and that it is in the right holes! In most cases, the body of the component should be snug against the component side (opposite from the "track" or soldering side) of the boards. Obvious exceptions are transistors and other components which might run hot. Looking at the solder side of the board, bend the leads outward at about 45 degrees to hold the component in place.

3. Inspect the unsoldered connection. Make sure you know where solder is supposed to go. For example, if there is a pad for another component very close to where you are going to solder, you can memorize the pad layout and be sure that there is no unwanted solder bridge when you finish the connection. If you don't do this, it's often hard to tell whether two points should be connected or not. Examine **Fig. 3** for an illustration of this.

4. Solder the connection. Tin and wipe the tip of the iron as described above. Apply the tip to one side of the pad, wedging the tip against the lead where it protrudes from the hole, as shown in **Fig. 1**. Count to three and apply solder to the opposite side of the pad, and it should flow across the pad, around the lead, and slightly up the lead from the surface of the board. Do *not* apply the solder to the tip of the iron, as it will melt instantly and may flow onto the joint without bonding properly. **Fig. 2** shows a good joint and a bad joint. The bad joint is often called a "cold" joint because it is most often caused by inadequate heating of the joint. It doesn't just *look* ugly. If I can coin a new phrase here, it's "electrically ugly," offering no electrical connection between the two surfaces, or a weak one which is bound to fail, or (worst of all) an intermittent fault.

5. Inspect the soldered connection. Use a magnifying device of some kind, ideally 5–10x power, and make sure the connection is sound and conforms to the illustration in **Fig. 2**. Make sure solder hasn't flowed onto any adjacent pads or tracks. If it has, remove it immediately (see "unsoldering," below).

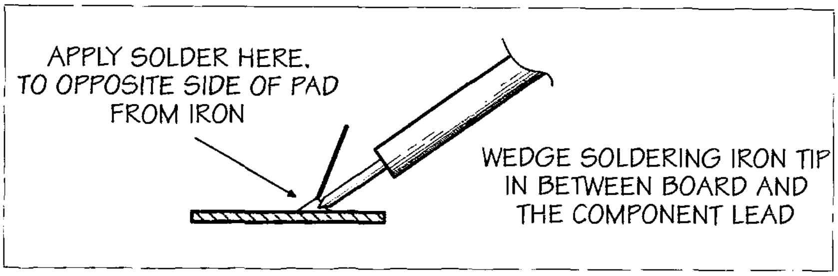


Fig. 1. Placing the soldering iron on the work.

6. Trim the component leads. Use your flush-cutting pliers and trim at about the point where the solder has risen up the lead. It is not usually necessary, or even a good idea, to trim the leads of integrated circuits and other devices where the leads protrude only an eighth of an inch or so.

That's all there is to it. With practice, you won't even need to think about the steps as you go through them. There are variations and some specialized techniques that will be helpful later, but usually they are self-evident, and we'll mention them when we come to them in the course of building our project.

When you've soldered all the components onto the board, check everything again—component values, orientations, and, above all, look for solder bridges and cold joints! When it comes to the latter two, it may be a good idea to remove excess solder flux from the board, but don't bother with that unless you really need to. In my experience, more problems are caused in the process of removing flux than are solved by it. If you do need to remove flux, use acetone or a commercial flux remover, in a well-ventilated area. If you have invested in solder with a water-soluble flux, you will use water, of course, but do make sure the board is thoroughly dry before applying power to it!

Unsoldering 101

For the most part, anything you can do with solder you can undo, if you know what you're doing. The secret is solder wicking braid, also called desoldering braid, a fine copper braid impregnated with flux. Used properly, it can remove virtually all of the solder from a connection. A component, even an integrated circuit chip, will just fall out. A lot of people seem to have difficulty with it, though. It's one of those things where it's hard to figure out how to use it by yourself. One big problem is that desoldering braid should be marked with a "use by" date! The braid itself can oxidize over time, and the flux can dry out and fall out of the mesh, making it practically useless. So use fresh wick, and do it like this.

1. Make sure the soldering iron is hot. Desoldering requires more heat than soldering, so if you have an adjustable iron, turn it up. And make sure the iron is tinned. That film of molten solder on the tip is essential for heat transfer into the work.

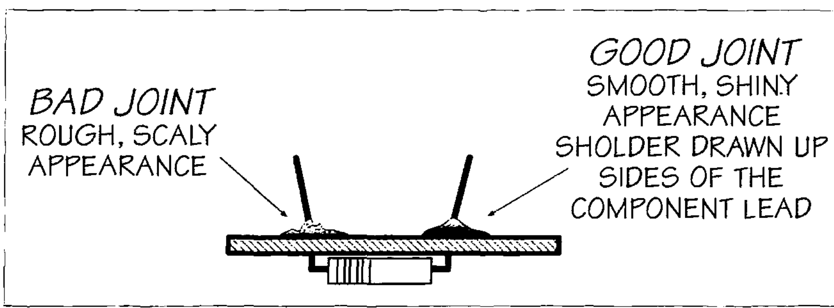


Fig. 2. Examine the work closely.

2. Lay the end of the wick on top of the connection that is to be desoldered, and press the iron firmly into the wick. Hold in place (you'll want to hold the wick by its container, or at least six inches from the end) and watch for solder to appear in the wick. When solder has been drawn about half an inch from the end of the wick remove the iron and the wick.

3. Cut the used end of the wick off, about a quarter inch above the point at which solder is visible. Solder has not been drawn up that far, but the flux has boiled out.

4. Repeat steps **2** and **3** until the component is free. It will usually take two or more applications for each lead. Keep in mind that where circuit board holes are plated through, solder has flowed down from the track side of the board and as a result there will be more solder to remove than on a simple single-sided board.

If you have trouble, remember that the two secrets are fresh solder wick and plenty of heat!

To repair (remove) a solder bridge, apply the wick to the bridge and the solder should be removed from the board between the two pads. You may need to resolder the connections, though.

Next time we'll build our project. In the meantime you can get your tool kit together, practice soldering, and order a kit. It's the VM-110 AC Voltage Monitor from Electronic Rainbow, and if you don't want to order the kit you can find most of the parts pretty easily. A list will be printed with the next of this series of articles, along with the schematic. The VM-110 kit costs $10.95 and you can order the complete kit or just the circuit board from Electronic Rainbow, or the complete kit from Milestone Technologies.

Sources:

Radio Shack: Call (800) 843-7422 for nearest location or to order by phone.

Electronic Rainbow Inc.
6227 Coffman Road
Indianapolis IN 46268
(317) 291-7269

Milestone Technologies, Inc.
3140 S. Peoria St., Unit k-156
Aurora CO 80014
(303) 752-3382
For Orders:
(800) 238-8205
E-mail: [sales@mtechnologies.com]
[http://www.mtechnologies.com/mthome]

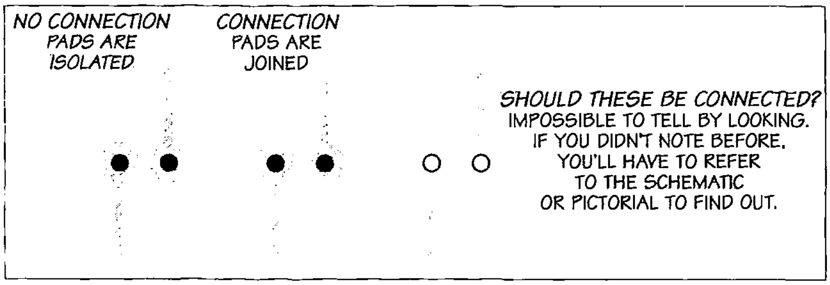


Fig. 3. Check and recheck for solder bridges, with a magnifying lens if necessary.

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

Wayne's Five Buck Books & Stuff:

Boilerplate. 45 of Wayne's ham oriented editorials. Great material for club newsletter editors who are always short of interesting items for filler.
Submarine Adventures. Wayne's WWII adventures on the USS Drum SS-228, now on display in Mobile, Alabama.
Wayne's Caribbean Adventures. Scuba diving and hamming all through the Caribbean. 11 islands in 21 days on one trip? You bet, and you can't beat the price either.
Wayne & Sherry's Travel Diaries. Cheapskate traveling to Russia, Europe, and so on. Now, how did Wayne and Sherry fly first class to Munich, drive to Vienna, Krakow, Prague, and back to Munich, staying at excellent hotels and eating up a storm, all for under $1,000?
Cold Fusion Journal – Issue #20. Read the latest scoop on cold fusion in this whopping 92-page sample issue. Cold fusion dead? No way!
Pure Silver Wire for making those miracle silver colloids. Two 3" lengths of #10 99.999 pure silver wire $15. Should last for years.
Bioelectrifier Handbook. Background, circuits, uses, etc. $10.

The Table Topper 160-Meter Loop

Compact, low-noise—and effective.

Richard Q. Marris G2BZQ
35 Kingswood House
Farnham Road
Slough SL2 1DA
England UK

Many amateurs and SWLs find it very difficult, if not next to impossible, to erect an effective 160m antenna. First, there are those in "no antennas here" zones. Others do not have the space to erect an effective conventional antenna. And any who live in an urban environment will probably have to exist with a high noise level anyway, which may be so high that the band is impossible to use.

At my QTH I do not have the space to erect one. Even with a short loaded wire, the noise level is intolerable.

Noise at these frequencies is either atmospheric or manmade. Both types are picked up by the antenna, as is QRM. Atmospheric noises are radio waves, produced by natural causes, of irregular waveform and usually very short, repetitive duration. They cover a wide range of frequencies, and the noise level increases as the operating frequency decreases. This noise may be directional or non-directional, depending on the cause—an extreme case being nearby electric storms.

Manmade noise seems to be getting progressively worse as the years go by. It can be produced by inside sources such as thermostats; dimmer switches; TVs; computers and other electronic devices; and, of course, the main power supply—house wiring.

Externally, you can also pick up many of these noise sources from neighbors (especially in apartment complexes); external power supply cables; road traffic; neon signs; and so on.

Fortunately, much of all this noise interference is directional, and can be eliminated or greatly reduced by using a directional antenna such as a well-designed loop.

Coming back to the 160m band after some years' absence, I decided to design a narrowband, narrow beamwidth, small transmitting and receiving loop to specifically combat these noise problems on 160m.

Small, tuned-frame loops can be either solenoid-wound "box" types, or "spiral"-wound loops. With symmetrical matching/feeding, they should produce the well-known "figure eight" polar diagram radiation pattern, giving a theoretical zero signal null at 90 degrees to the line between the TX to RX signal path.

The box loop is the most convenient to construct, but unfortunately signals cannot be completely eliminated at 90 degrees. However, the more difficult to design and construct spiral loop can eliminate all signals at 90 degrees to the TX-RX signal path. Also, it does not need direct earthing/grounding.

The Table Topper 160 loop configuration

First, I constructed a spiral octagonal loop. This was tuned with a variable capacitor and successfully loaded with a low-power 160m CW TX. On a good RX, both European and trans-Atlantic signals came through when conditions were OK. However, living in south central England, I found that North American stations were received on the forward lobe, while European signals were recoverable on the reciprocal or opposite lobe. The nulling at 90 degrees effectively eliminated all signals. Noise levels were dramatically reduced.

I then conducted experiments with alternate shapes of spiral loops, using the same amount of wire turns and alternate methods of feeding/matching. At each stage, I did comparisons with the original octagonal spiral loop, the object being to (1) increase signal strength in and out and (2) if possible, reduce the size of

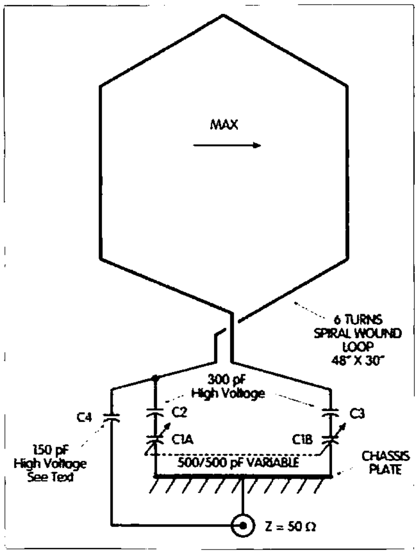


Fig. 1. Loop schematic.

the rear lobe while increasing that of the forward. This would reduce the reciprocal bearing QRM (on receive) and increase the signal strength on receive and transmit. Atmospheric noise would also be further reduced.

The final TT160 loop is shown in **Figs. 1** and **2.** I found that by reducing the loop's width dimensions and increasing its height, the signal strength significantly increased when compared with the original octagonal spiral assembly. The excellent nulling at 90 degrees was increased, too. Experiments also indicated that by adopting an asymmetrical feed, as in **Fig. 1**, the forward lobe could be increased and the reciprocal, decreased.

The end result was most satisfactory when the loop was pointed toward North America, where excellent W and VE signals could be heard, although the reciprocal European signals were greatly reduced. Rotating the loop through 180 degrees meant the opposite happened. Furthermore, the new shape and feed method gave the loop a narrower beamwidth which, with the loop's usual narrow bandwidth, reduced manmade noise and atmospheric noise to acceptable levels. The new radiation pattern was similar to **Fig. 4b**.

Loop construction

Refer to **Figs. 1** and **2** for the final loop assembly, just 30 inches wide and 54-3/4 inches in overall height, including the base mounting chassis. This is a size which can easily be accommodated on a tabletop and then stowed away when not required.

The TT160 consists of six spiralwound turns of PVC-covered wire (24/0.2 mm) with an OD of 2.05 mm and rated at 6 A. Any 6 A-minimum PVC-covered wire would suffice. The turns are supported by six-way terminal blocks, cut from 12-way standard ones (Radio Shack™ #274-679). It is important that the loop turns are wound counterclockwise starting at the outside and fed progressively through the terminal block holes. The inner wire end goes to a three-quarter-inch standoff insulator (**Fig. 2**), which ensures that the wire end drops down to the VC (variable capacitor) with a half-inch clearance away from the loop turns. The loop frame is made from well-seasoned hardwood as shown in **Fig. 2**.

The baseboard is 12 x 9 x 3/4-inch timber, onto which is mounted the simple chassis. This is a piece of 8 x 4 x 1/2-inch timber faced with single-sided copperclad Fiberglas™ board (8 x 4 inches), with the copper surface upwards. It is fronted by an identical board to form the panel. The copper surfaces of both boards should be seam-soldered together. At the rear of the baseboard is mounted a timber vertical loop frame support 13 inches long by one and three-quarter inches in diameter (see **Fig. 2**). The edge of this should be planed off to a small flat surface to allow the loop frame to be screwed to it as shown.

The two-gang by 500 pF-per-section variable capacitor (C1A and B) is mounted on the front panel. This VC should be of the larger, rigid, well-spaced, receiver type, with ceramic-mounted stators, which could well be salvaged from an old tube receiver. I used a Jackson type "L". In series with

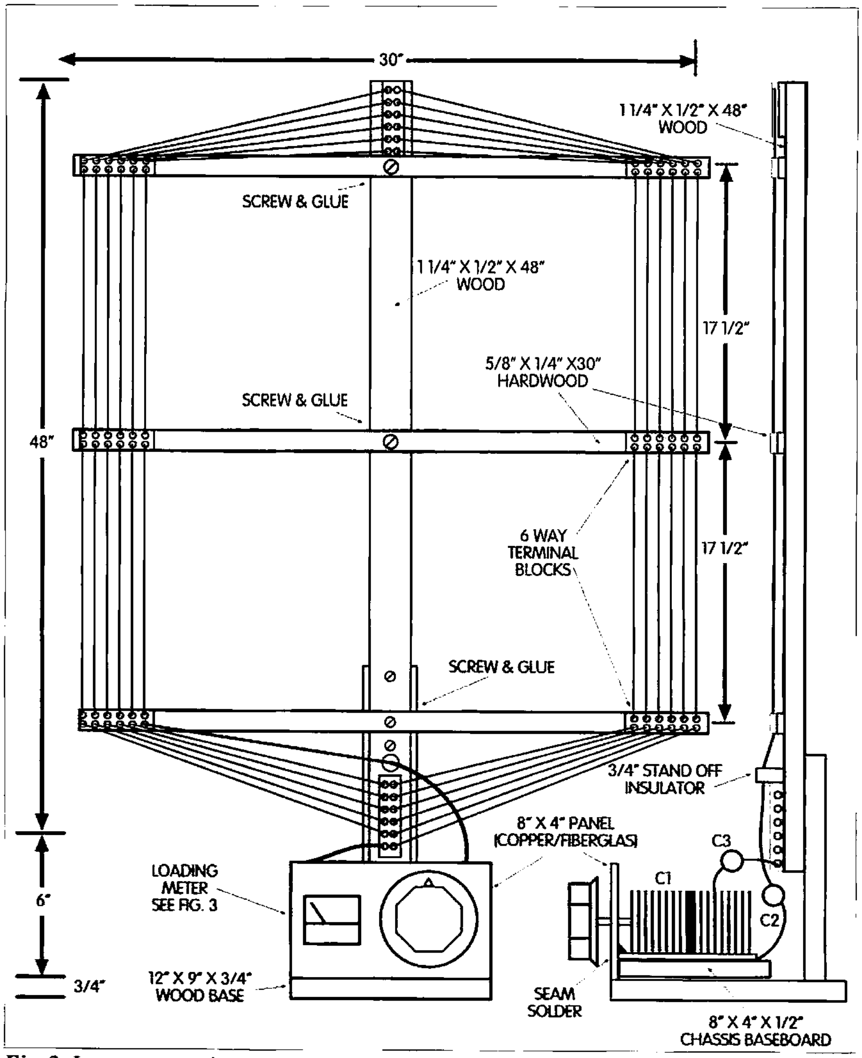


Fig. 2. Loop construction.

C1A and B are two 350 pF high-voltage ceramic disc capacitors (8 kV) which were from the junk box. Each is fitted to

> ***"There are no prizes for electrocuting the cat!"***

a small piece of perforated board and incorporated in the wiring between the loop and VC.

The coupling loading capacitor (C4) is 150 pF high-voltage. Once again, an 8 kV rating from the junk box. The ceramic discs could be, say, 2 kV working, depending on what is obtainable. C4 couples the outer end of the loop winding to the 50-ohm coaxial socket, mounted facing the rear, so that the cable exits at the zero signal area of the radiation pattern.

Setting up and operating

The TT160 is fitted with a simple front-panel loading/tuning meter as shown in **Fig. 3**, consisting of a 250 μA meter with two diodes and a pickup coil. 1N4001 diodes were used, but any small ones would suffice.

The meter could be 100 μA if available. It is mounted on the front panel, as shown in **Figs. 2** and **3**. The pickup coil is a few turns of PVC hookup wire wound on a three and a half-inch length of three-eighths-inch diameter wood or plastic rod. Two pins are pushed through the rod, as shown in **Fig. 3**, forming the connecting point for the diodes and the pickup coil ends. The number of wire turns will depend on the type of meter and TX power used (see below).

No ground connection is required for the loop, although of course the TX and RX should be grounded.

The loop's narrow bandwidth ensures that no harmonic output, or TVI, can be detected when you are running about 15 watts CW. C1A and B have been found to be okay when tested up to just over 20 watts. If a much higher power is to be used, then a TX-type variable capacitor and thicker loop wire will be necessary. For safety reasons, higher power is not recommended for use in an indoor environment. There are no prizes for electrocuting the cat!

A simple loop-rotating turntable would be an advantage. This turntable should not be of the free-running ballrace type, since the stiffness of the coaxial cable would take charge.

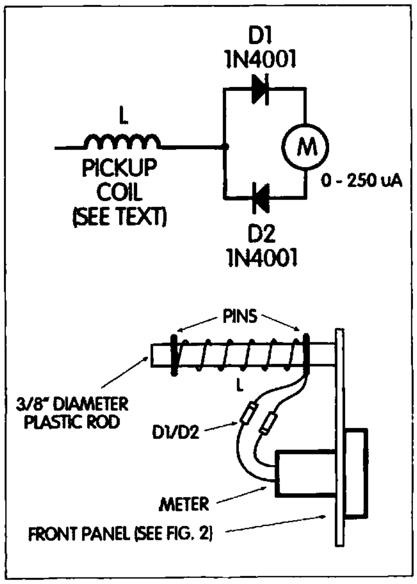


Fig. 3. Loading meter.

A few feet of RG-58 coaxial feedline should be connected between the loop and the TX/RX.

An operating frequency should be selected for the initial tests. The TX/RX should be loaded into a dummy load. On receive, the loop tuning capacitor should be carefully rotated to resonance by noting an increase in signal strength. Then rotate the loop for maximum signal, i.e., to the bearing of the station being received. Then, with a field strength meter nearby, switch to transmit. If necessary, readjust slightly for maximum indicated radiated signal on the field strength meter.

Next, put a few turns of hookup wire on the dowel rod and note the indication, on the panel microammeter, of the loading/tuning meter. The number of turns should be increased/decreased to the point where maximum radiated power from the loop produces about three quarters of a full-scale reading. The number of turns depends on the power of the TX. In the future, this three-quarter-scale meter reading will be your reference that all is well. When retuning the TX to another frequency, it may be necessary to slightly adjust the loop tuning knob to frequency, indicated by your maximum meter reading.

Remember: The bottom line for best TX performance is *maximum indicated output!*

The Table Topper 160 is an effective, low-noise, compact antenna. Its frequency range is 1600 kHz to 2000 kHz, with overlap at either end. It is equally useful for the transmitting and/or listening amateur, and will give a good account of itself as an indoor 160m TX antenna, too. No doubt someone will devise a remote control version for use in the attic—I'd love to hear about it.

On receive, the DX performance is quite dramatic when used with a good RX (no preamp being used). The low noise level, along with narrow beam- and bandwidth, ensures easy and comfortable listening. The TT160 has also been used for receiving DX and other beacons between 1600 and 1700 kHz. This also makes it a good prospect for those licensed for the MEDFER experimental transmitting band. Happy looping!

Suggested reading

Admiralty Handbook of Wireless Telegraphy, Vol. 2, 1938.

Antennas, Kraus.

Radio Engineering, Terman.

Handbook of Technical Instruction for Wireless Telegraphists.

Parts List

68 ft.	PVC-covered wire flex (24/0.2 mm), OD 2.05 mm, rated at 6 A. Other 6 A wire could be substituted.
1	500 and 500 pF 2-gang variable capacitor. Well-spaced rigid receiving type, with ceramic stator insulation. Jackson type "L" was used on the prototype.
4	12-way terminal blocks (RS #274-679), each bisected to form 8 6-way blocks
2	350 pF ceramic disc capacitors, 2 kV minimum
1	150 pF as above
1	3" diameter knob
2	8" x 4" Fiberglas™ single-sided copper board
1	1-1/2" x 1-1/2" meter (50, 100, or 250 μA)
2	Small diodes (1N4001 used)
1	3/4" standoff insulator
1	Wooden base 12" x 9" x 3/4"
1	Chassis, wooden baseboard, 8" x 4" x 1/2"
1	48" x 1-1/4" 1/2" hardwood, plus 13" x 1-3/4" diameter dowel
3	30" x 5/8" x 1/4" hardwood

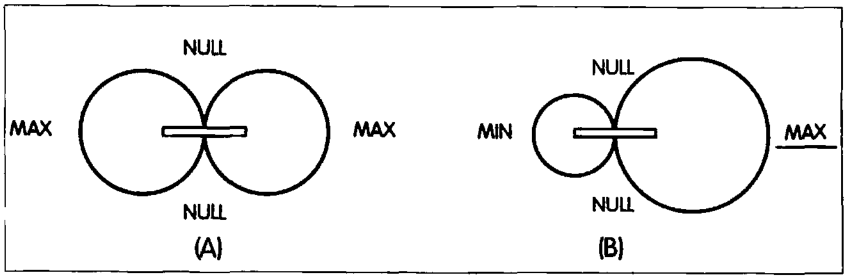
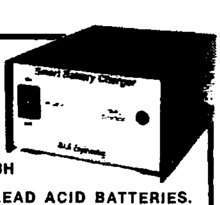


Fig. 4. (a) Theoretical figure eight radiation pattern of small loop. (b) Plotted pattern of the Table Topper 160.



Colby's Do Something Box

How about making a great gift gadget for the grandkids?

Evert Fruitman W7RXV
2808 West Rancho Drive
Phoenix AZ 85017-2646
[Fruitman@asuchm.la.asu.edu]

For many years, scientists, engineers, and mothers have tried to find something for an active five-year-old to do besides watch TV and listen to the radio or tapes. Besides, these activities are not as interactive as hanging onto Mother's arm.

And although the sandbox makes a nice outside activity for kids, many times they need an inside one. *They* still want something to do that they can do all by themselves. *We* want them to do something that should not result in the partial destruction of the house or the partial loss of Mother's composure. With those thoughts in mind, I dug through the junk box and came up with the parts for my grandson Colby's "Do Something (besides annoy his mother) Box."

This Do Something Box consists of a number of basic building blocks. You may wish to start with just a few of them and add others later, depending on how the child's interest span—or yours—varies.

Of course, a normal five- or six-year-old will have a moderately long—or a moderately short—attention span (depending upon your viewpoint). That means that the Box should offer a variety of entertaining things for them to do. Most youngsters like blinking lights, wiggling needles, and especially noisemakers. Also, they want to change the speed of the lights, and the type of noise "all by themselves."

As a practical consideration, the Box should be portable to allow its use in any room in the house, as well as in the sandbox or in the car, especially during long trips. I still remember when our son, Colby's uncle, discovered the built-in interactive noisemaker in the back seat of our car. The first and the last time he snapped the top on the rear seat ashtray ensured that I was wide awake for the next several miles and trying to think of something else for him to do on trips. The Box should run for at least a year without someone having to change the batteries, and it should run on a pair of size D cells until they fall well below 1.2 V each. Also, it should turn itself off after a reasonable time. That will extend battery life and turn off the noise or the lights when it gets forgotten or "put away" during an impulsive moment.

Before you write to ask the editor if my spaceship is double-parked, let me say that Colby has been using his Box for two years. Both he and his mother like it, particularly because of the relatively quiet noisemaker, the auto turn-off feature, and the fact that they have not had to change the batteries yet.

Overview

Fig. 1 breaks down the Box into its individual blocks. It consists of (1) the battery; (2) the time delay/auto turn-off switch; (3) the blinking LEDs; (4) the sound generator; (5) the battery tester; (6) the meter driver; and (7) other options—something else that you want it to do. You will see how each basic building block works, and then put the whole system together. Of course, if you have more interest in getting it together than in how it works, skip to the construction section right away.

The battery

For practical reasons, the unit should run at least a year before it needs a battery change. I used a box without the little battery access panel. "An ounce of prevention ... " keeps them from opening the battery compartment and losing the batteries, or worse.

Size D cells should run a light load like this for at least a year of normal, intermittent use. Smaller batteries would

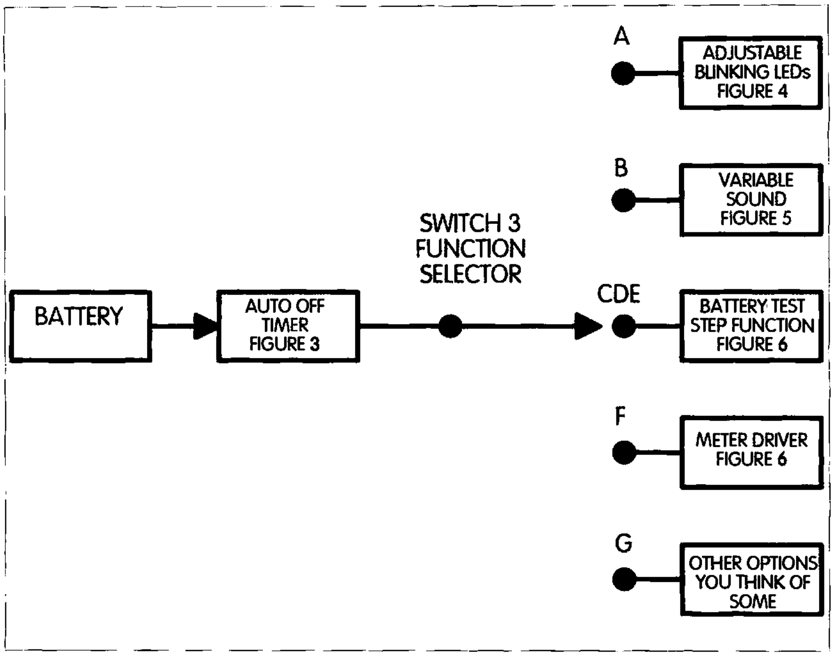


Fig. 1. Block diagram.

make the Box smaller and would probably run it a reasonable time, but you can find the D cells at just about any hardware store. Without the battery access panel, you have to dig up a screwdriver and take it apart in order to change the batteries. This latter feature is designed to keep Junior from doing it himself. Of course, you can customize this project to suit your wishes. If you want, you may use AA or even AAA batteries and expect reasonable life from the batteries thanks to the relatively low current drain and the auto turn-off feature.

Time delay, auto turn-off

For many years, calculators have used the auto turn-off feature, but they use a rather small amount of power, typically 3 V at a few microamps for the LCD type of calculator. Applying that idea to a toy that draws a moderate amount of current, 2–20 mA, presents something of a challenge.

Using a relatively low supply voltage precludes the use of just a Darlington pair as the main element in the switch. A Darlington pair is the stacked dual-transistor circuit that has a high input impedance which lends itself to the auto turn-off feature. In this case, though, the cascaded junctions would use up too much battery voltage and limit the useful life of the batteries, or make it necessary to use more batteries. **Fig. 2** shows a Darlington pair driven by the voltage from a capacitor. The Darlington pair drives a relay in a time-delay circuit.

As the capacitor charges or discharges, the relay will change states—turn-on or turn-off. Pushing the START button will charge the capacitor through RA. When the voltage across the capacitor reaches about 1.2 V, QA and QB will start drawing current through RB, their emitter-base and their emitter-collector circuits. The emitter-base current in QA will cause, say, one hundred times the current to flow in its emitter-collector circuit. Since the emitter of QA goes directly to the base of QB, any current in the emitter of QA must flow through the emitter-base circuit of QB. That current, in turn, is multiplied by the gain of QB, which results in much more current flowing through the emitter-collector circuit of QB. In this case, that includes the relay. This so-called "piggyback" configuration is called a Darlington pair.

The Darlington pair can take a few microamps in the first base and multiply it to the milliampere level in the collector of the second transistor. A quick example will help show this. A 2N3904, QA, has a minimum DC current gain of 150. Connecting two of them this way gives us a minimum current gain of 150 x 150 or 22,500. Feed 1 µA (0.000001 A) into QA and QB can deliver a nominal 22.5 mA (0.0225 A) to the load. Since a relay may want five times that much current, or 100 mA, you would need to feed 5 µA into QA. Not bad, since that would represent a nominal 240,000 (240 k) ohm load to the timing capacitor. (I will save the math on that one for another time.) With a reasonably-sized capacitor, you can get a useful time delay for the relay out of this circuit.

By placing a resistor between the capacitor and the base, as well as a resistor between the emitter of QA and the base of QB, you can make the resistance across the capacitor go up quite a bit. That will give many minutes instead of several seconds of time delay without putting in a larger capacitor. While you can use this improved circuit to drive a relay, a relay draws more current than you want to use for the Box. In fact, the relay draws more current than the rest of the project. So you will do something else to make an automatic off switch for your Box. We will modify the switch circuit so that it drives a single transistor. That will take the place of a relay to turn on your Box.

One more thing about this simple Darlington pair relay driver circuit. Connected this way, the output transistor has about 0.7–1.2 V across it, even if the base of QA has a lot of drive, base current, fed into it. With a relay as the load, the missing nominal one volt does not make that much difference in the way the circuit works. A 12 V relay will turn on with less than 10 V across it. That is fine if you have a 12–14 V supply. Our Do Something Box has only three volts available. So, in this case, a single power

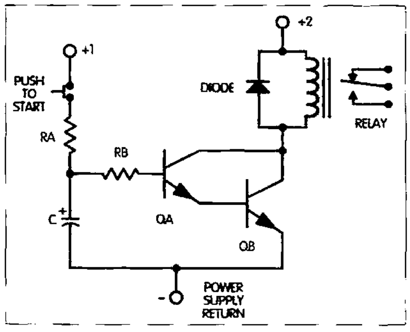


Fig. 2. Typical relay-based power control circuit. Power supply for +1 may be same as PS for +2. In some cases it may be a higher voltage so that capacitor C will take longer to discharge, keeping the relay on longer.

transistor will be used as the on/off switch. It can have as little as 0.05 V (50 mV) lost across it.

You can determine the most current that the circuit will draw, then find a power transistor that can deliver that amount of current. A power transistor has to have some current driving it, as does a relay. A suitable transistor, however, will draw less base current than a corresponding relay. The relay coil may draw 100 mA–200 mA, while a transistor could turn on the same load with only 1 mA base current. Base current does to a transistor what current in the coil does to a relay. Most relays are designed to handle much more power than this little Box draws. A transistor makes an ideal on/off switch for this project. As a bonus, since the transistor has no moving parts, you will find it more reliable, cheaper, and easier to get than a relay.

The circuit that looks at the voltage on C1, the timing capacitor, must draw the smallest possible amount of current as the capacitor counts down the turn-off time. By using a combination of the Darlington pair and a complementary pair, you can get the desired high resistance across the timing capacitor and still have a low-loss on/off switch. If the capacitor sees a low resistance, you will get only short timing with practical values of capacitance. The working circuit is much simpler than it sounds.

Look at **Fig. 3**. With the values given for C1 and R1, the simple auto-off switch gives about 15–20 minutes run time and only 0.03 V, 30 mV, loss across Q3. That makes Q3 a respectable switch at these current levels. The switch losses can and do go up at higher current levels.

When you push the START button, C1 charges through SW1 to the battery voltage. Some applications need resistor RA in **Fig. 2**. You do not need that resistor to limit the input current here, so you may leave it out. R1 limits the current from the capacitor, C1, into the base of Q1. It also raises the input impedance of what the capacitor sees, thereby giving reasonable ON times with practical parts. With R1 = 82 k ohms; and C1 = 22 µF, the circuit gives about 10–15 minutes run time.

When the voltage across C1 reaches about 1.2 V, current flows through the emitter-base junction of Q1, R1, and the emitter-base junction of Q2. That causes Q1, Q2, and Q3 to turn on. When Q2 turns on, current flows through R2 as well as the base-emitter junction of Q3, turning it on.

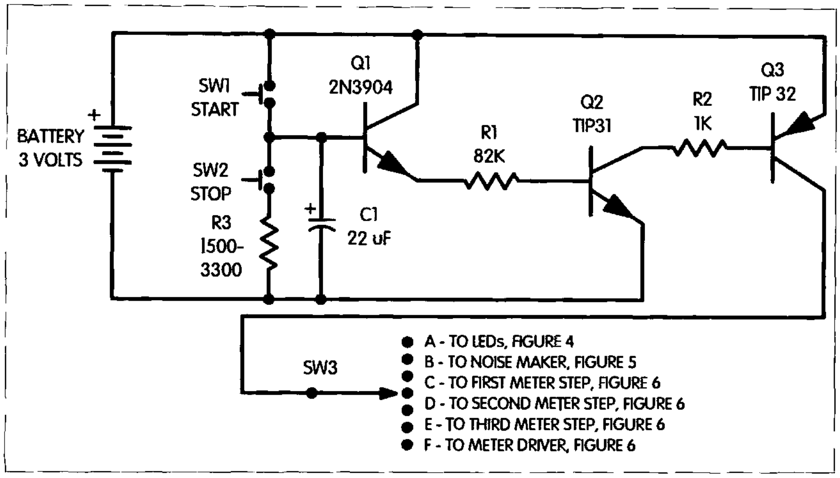


Fig. 3. Auto-Off switch.

Q2 and Q3 form a complementary pair: in this case, a direct-coupled NPN and PNP transistor. When Q2 turns on, it causes Q3 to turn on, which supplies current to the part of the Box selected by SW3. Here, a modified Darlington pair samples the voltage across the timing capacitor. Note that the collector of Q1 goes directly to the plus supply line. That eliminates the usual higher voltage loss a Darlington pair has across the output transistor, Q2. Although you still have two emitter-base junctions in series across the capacitor, they combine with R1 to give an exceptionally high impedance across the timing capacitor. That gives a long-time-delay auto-off switch. In case you were wondering, Yes, you could do all of this with an op amp. But, you would have to use a higher supply voltage or look for a harder to find, special low voltage op amp.

Pushing SW2 connects R3 across C1, the timing capacitor. The 1500–2200 Ω resistor bleeds the charge off the capacitor in a fraction of a second, turning off the Box. This gives you the option of a manual turn-off. Without R3, if or when someone pushes both buttons, it would place a direct short across the battery.

The resistors R1 and R2 supply the bias currents to Q2 and Q3. R1, Q1, and to a lesser degree, R2, set the load seen by capacitor C1.

Here is one of the useful things about this modified Darlington pair, Q1, Q2, that you may want to put into your notebook. The input impedance, looking at the left side of the base of Q1, is set by the value of R1 multiplied by the DC current gain of Q1. With a 2N3904 and a value of 390 k ohms for R1, the input impedance of Q1 (at the base) is ~390,000 x 150 or 58 meg (million) ohms. That gives you what the capacitor likes to see in order to give the switch long ON times, a high impedance load. Simply stated, the switch needs only a few microamps to turn it on. With this circuit, you can get that from a small capacitor for many minutes. That makes the switch practical. It also makes the Darlington pair useful for other applications.

Start your timer

This timing circuit turns on as soon as you hit the START button, and for quite a while it maintains practically the full battery voltage across the load. However,

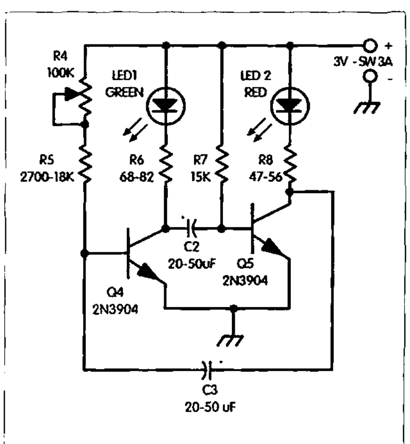


Fig. 4. LED driver.

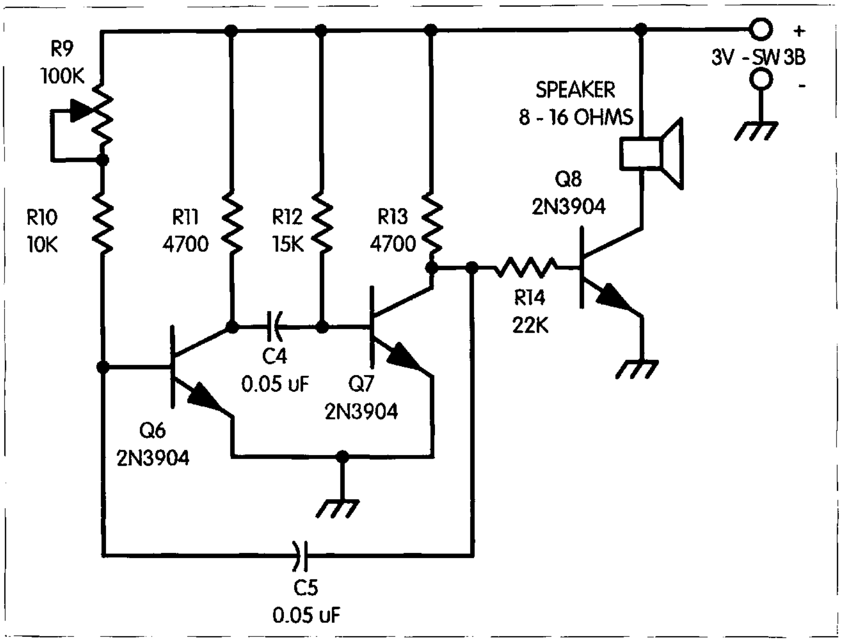


Fig. 5. Sound generator.

after a while it tends to fade from a certain point in the shut-down sequence before making a complete turn-off. This happens as Q3, from **Fig. 3**, starts to fall out of saturation. As it starts to develop a higher voltage drop across its emitter-collector, it becomes a less efficient switch.

As the voltage across the switch increases, the voltage across the rest of the circuit decreases. It still works, but the LEDs get a bit dimmer or the sound from the speaker gets softer. Some systems require a sharp turn-off, but not this one. So you can use a simple, cheap, but somewhat sloppy switch, as part of a toy that turns on at the push of a button and remembers to turn itself off without a reminder from anyone. Like the other basic building blocks described here, you could find other applications for this switch. You might have to adjust some of the circuit values to fit your other applications.

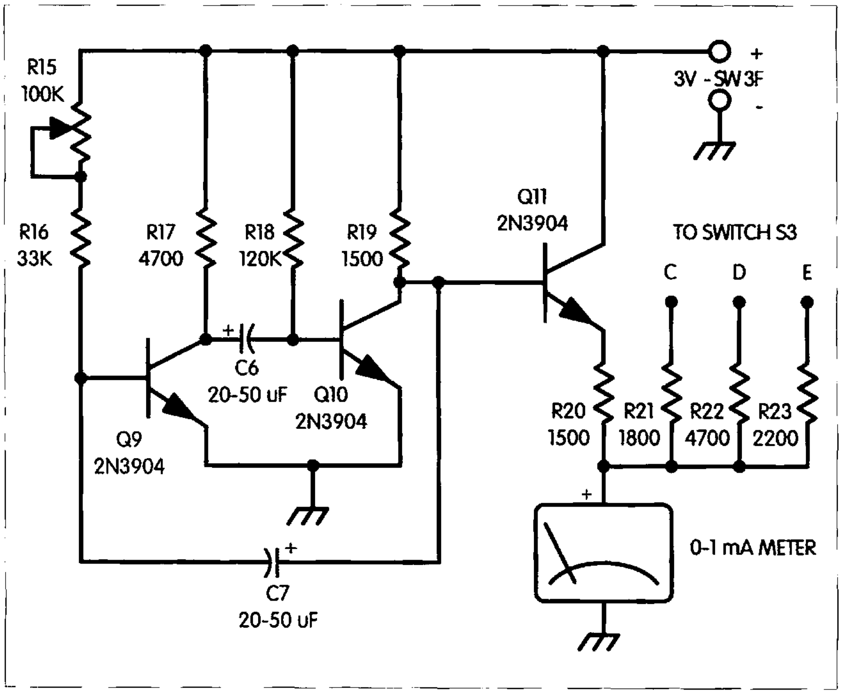


*Fig. 6. Meter driver. See **Table 1** for R20–R23 values for other meters.*

LED driver

Here you have another basic building block, the astable multivibrator. Its formal name means that one of the transistors will turn on for a while and the other one will turn off; then they will switch. It cannot have one of the transistors turn on, and the other one off, and stay in that state. Because one of the transistors turns on and the other transistor turns off, then after a period of time, they change to the other condition, this circuit is commonly called a free-running flip-flop. This is another one of those simple but versatile circuits.

When the LED flasher in **Fig. 4** first gets power, one of the transistors starts conducting first. It turns on because of the bias supplied by the resistor from the base to the plus supply. That also causes the capacitor connected to its collector to charge through the other base-bias resistor. While it is charging, the voltage at its far end (the end connected to the base of the OFF transistor) is too low to turn on the second transistor. When the capacitor finishes charging, the voltage at the base end of the capacitor rises enough to turn on the second transistor.

Because the capacitors connect the collector of one transistor to the base of the other transistor, the action will continue. One transistor will turn on while the other one turns off. The capacitors alternately charge and discharge. The rate at which this happens depends upon the value of the resistors and the capacitors. The size of the capacitors and the base bias resistors have the greatest effect on the speed at which the capacitors charge and discharge.

The resistor and capacitor values set the frequency of the action. You may choose these values so that it takes so much time for the transistors to switch back and forth, you can almost keep track of them by postcard. At the other end of the scale, you can use small enough resistor and capacitor values so that the transistors will switch on and off several hundred thousand times per second. For

this application, you will use values that will cause the LEDs to blink at a moderately slow rate so that our eyes can follow them.

The combination of the RC values for the meter circuit, **Fig. 6**, will cause it to tick-tock about once every couple of seconds. The values chosen for the noisemaker function, **Fig. 5**, will produce a sound that ranges from the low end up toward the middle of the piano. Colby's Box has a nominal 4-to-1 (two-octave) range. The same basic circuit—but with different values of R and C—will give a wide range of frequencies out of this simple oscillator. That will allow its use in several different applications.

Changing the speed or the sound (all by myself)

By varying the value of the base resistor, you may vary the time constant and therefore the frequency of the oscillator. A potentiometer (volume control) wired as a two-wire control makes a convenient way to vary the base bias and, more importantly, the RC time constant. This has been done with R4 in **Fig. 4**, and another pot could be added in series with R7. This would allow tweaking for equal on-off times.

You *must* include a fixed resistor in series with the pot(entiometer). Without the fixed resistor to limit the current, when the pot gets to the end of its travel with the least resistance in it, it would connect the emitter-base junction of the transistor directly across the battery. That would destroy the transistor. Once the emitter-base junction starts conducting, at about 0.55-0.7 V, you *must* limit the current through it. The same goes for the LEDs as well as other PN junctions such as rectifier and signal diodes. The resistor in series with the collector and the LED limits the current to a safe value. It is large enough to limit the current but small enough to give a reasonably bright light.

Noisemaker

The noisemaker uses the same basic circuit as the LED flasher, but with a slight change of values. That changes the timing and the frequency. It also has one more transistor in it. That added transistor isolates the relatively heavy load from the basic flip-flop or, as I call it, the oscillator. Since the speaker draws a lot of current, it looks like a heavy load.

In **Fig. 5**, you can see a resistor, R14, between the collector of the second transistor and the base of the speaker driver. In essence, when the second transistor turns off and on, it alternately supplies and removes base drive to the output stage Q8. Since this happens at an audible rate, the current through the speaker turns on and off, producing sound. An audible rate simply means a rate from 20 to 20,000 times per second. That is the textbook definition of frequencies in the audible range (no, I cannot hear anything above 12,000 anymore). Changing the value of R9 makes the sound vary from a low buzz to a high-pitched squeal.

The collector resistor, R13, of the second transistor, Q7, would limit the current in the emitter-base junction of the output transistor Q8. However, without the 22,000 Ω resistor in series, the e-b junction of Q8 would look like a low resistance load across the second transistor. That would upset the timing circuit (understatement!)

If you want more noise out of this section, you may use a somewhat smaller resistor, a Darlington pair for the speaker driver, or both. Speaker impedances other than 8–16 Ω will work, but the volume will vary accordingly. Putting holes in the Box may make it loud enough without having to add parts. I suspect that Colby's mother enjoys the somewhat quieter sound more than he does. When he gets a little older and can read this, he may want to change it.

Meter driver

Before getting into "how and why" the meter circuit works, I will point out a couple of things in general about the meter. At one time, you could find analog meter movements at surplus stores or used meters in your spare parts box. Today, they are somewhat less available. Also, the price has gone up, making most new meters too expensive for a project where their delicate mechanical nature may get tried to the breaking point.

An analog meter movement usually consists of a coil of fine wire suspended between the poles of a permanent magnet. Older meters used pivots on jeweled bearings (lower friction). Better meters

Meter Sensitivity	R20	R21	R22	R23	Standard Values Used to Make the Needed Resistance
50 µA	48 k	330 k	30 k	60 k	48 k = 47 k + 1 k, 30 k = 15 k + 15 k, 60 k = 56 k + 3900
100 µA	24 k	180 k	15 k	30 k	24 k = 22 k + 1800 *or* 22 k + 1 k + 1 k, 30 k = 15 k + 15 k
200 µA	12 k	90 k	7500	15 k	90 k = 82 k + 6800 + 1200, 7500 = 6800 + 680
500 µA	4800	36 k	3000	6 k	4800 = 4700 +1 k, 36 k = 33 k + 2700, *or* 33 k + 1500 + 1500, 6 k = 5600 + 390
1000 µA 1 mA	1500	18 K	1500	3000	
5 mA	NR	3600	270	600	

***Table 1.** Resistor values versus meter sensitivity. See **Fig. 6**. Under the heading Standard Values are ways to make up the nonstandard resistors. Remember, this is a toy—not a precision instrument. Some of the composite values will work with only two resistors instead of three. Connecting a resistor, the meter, and a battery together will tell you if that is the value to use for the desired effect. Some of the values add up to a small percent less than the specified value. That will let the meter read a bit higher than the nominal 10%, 50%, etc., of full scale.*

use a taut band for the suspension. That gives even lower mechanical friction at the expense of a higher priced, more delicate instrument. A hard mechanical jolt could damage or even destroy one of these meters.

Despite the high resolution of digital meters, analog movements still find many applications. In this case, a digital meter lacks the "wiggling needle" repetitive, physical, motion wanted as one of the features of the Box. We will now look at how to add a meter to the Box, while keeping in mind its limitations. If you want to, you can add this feature later, when Junior is less likely to break it.

Colby's mother grew up around AM, FM, TV, and amateur radio transmitters and test equipment. She knew about the delicate nature of meter movements. That, combined with the type of meter used in Colby's Box, seems to have helped preserve it.

The ticking meter

A quick glance at **Fig. 6** will show a familiar sight: a flip-flop with a driver transistor, Q11. It will also show a couple of differences. The load is in the emitter of the driver transistor.

It also has some range resistors for the meter. The range resistors allow the meter to make discrete steps from zero to full scale in four steps. You could use some of the empty switch positions and have the meter step in 1, 2, 3, 4, 5, ... sequence.

With the switch in a blank position, the meter has no current flowing through it. As you step the switch through the range resistors, you change the current in preset amounts. By picking the correct resistor values, you may set the first step for 20% of full scale deflection and the second step for 50%.

By setting the last step for 100%, in this case three volts, you have a built-in battery tester. Actually, it shows how much battery voltage the switch applies to the rest of the circuit. Basically, taking a reading right after pushing the START button gives a good indication of battery condition. Of course, you may use more steps. The net effect of the step voltage readings is meter movement that seems to follow the motion of the selector switch.

By placing one side of the meter on the common line, battery minus, you can sample the switch voltage as above, or you can drive the meter with an emitter follower.

An emitter follower applies most of its input voltage to the load. The driver, Q10, sees a much higher resistance than it would if it were connected directly to the load. In this case, that resistance is about 150 times the combined resistance of the resistor R20, going from the emitter to the meter. For a 0–1 mA meter, the meter and the resistor combination would be roughly 3,000 Ω without Q11. With Q11, the second transistor in **Fig. 6**, Q10, sees about 450,000 Ω. That is much more than ten times the value of resistor R19, in series with the collector of the second transistor. That gives Q10 a good degree of isolation from the load.

The first two transistors in **Fig. 6** make a flip-flop that runs at a rather slow rate. It runs roughly from once a second to once every three to four seconds. The third transistor isolates the meter from the flip-flop. Normally, you might connect the meter to the collector of one of the first two transistors. If you did that here, you would lose the simplicity of the wiring for the step movement function. By using the follower for isolation, you can use a single, simple, rotary tap switch to get a wide variety of entertaining functions.

Matching the meter to the circuit

In **Table 1** I did the arithmetic for you, but feel free to check it. Depending upon what size meter you can get, you should find a set of resistor values to suit a meter with sensitivity ranging from 50 µA to 5 mA. These are the most commonly found meters.

Putting it all together (construction)

You may use any layout you find convenient. None of the circuits have high gain (amplification) that would cause trouble with feedback. None of them run at a high frequency which could give crosstalk (that is where two circuits couple energy or "talk" to each other). Finally, none of the circuits draws particularly high current. That says that you may do what you like with your common or ground circuits. In short, you may use a printed circuit board for the ultimate in neatness. You may use perforated board for convenience, or you may

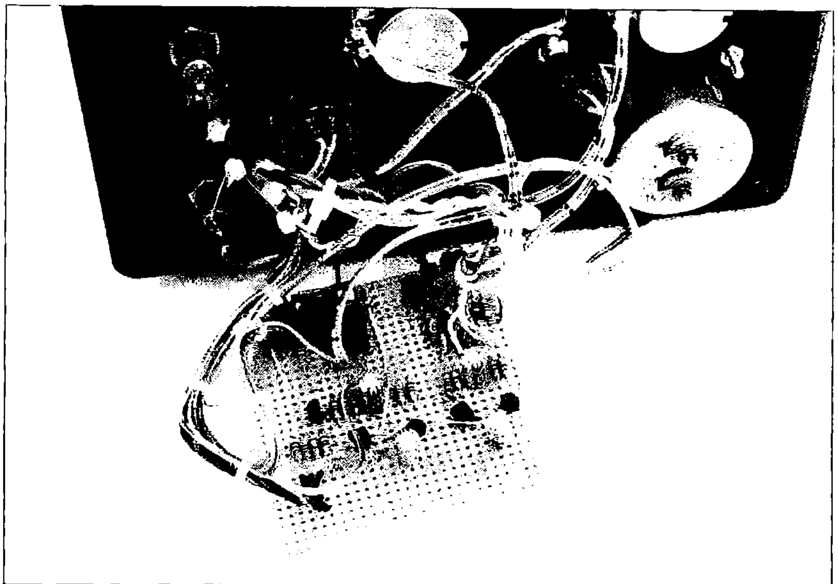


Photo A. Perfboard layout. Top of photo shows rear view of front panel. START and STOP buttons on left side. Switch 3 is near center of panel. Meter is on the right just below the control to adjust the speed of the meter ticking. The LEDs are to the left of the meter and its post. The text tells where the various sections are on the perfboard.

use no board, as I have been known to do, for speed of construction.

PC boards

You can choose to use tape to make a rough layout for each section. That way you may make just one or more of the functions. A single layout for the entire system would make it difficult to pick out just the desired function(s) if you did not want to make all of them. Simply make the boards that you want and tie them together at the indicated points, battery minus and SWITCH 3 connections.

If you plan on mass producing these items, or if you want a much more durable but less flexible finished system, use a PC layout. The other disadvantage of a PC layout is the extra time it takes. Once done, it is quite difficult to make changes to it. Despite all of that, I usually do use PC layouts—but not for a circuit that I may want to change not too long after finishing it. If this is one of your first projects, you might enjoy it more by saving the trouble of a PC layout for another time and using perforated board this time.

The perforated-board model, **Photo** A, shows this type of simple layout. Thin speaker wire makes a convenient way to connect the switches, the pots, and the circuit together. The nylon ties tidy up the wiring. Feel free to make the connections long enough to go around the same side of the board. That will let you lift the board out as needed.

Meter driver

The meter step function resistors and the meter flip-flop are in the lower left side of **Photo A**. A piece of multicolored cable connects the resistors to the FUNCTION SELECT switch. Consult **Table 1** for the resistor values. Just to make sure that those values fit your meter, connect

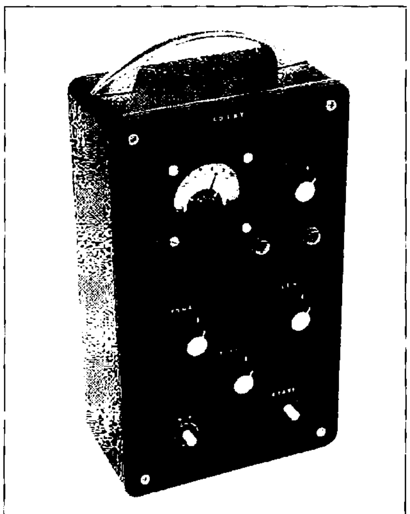


Photo B. The finished Box.

one resistor, the meter and a battery, 1-1/2 or 3 volts, in series. It takes just a couple of minutes to do these suggested pre-construction tests, but it can save a lot of time if you have an undesirable value. It takes me longer to remove wrong parts from a board than it did to put them on the board in the first place.

LED driver

The LED driver circuit is on the right side of the board. Note that the transistors Q5 and Q6 are rotated 180 degrees from each other. That makes it easier to connect their emitters together. I did the same thing on the other two circuits that use a flip-flop.

You will want to pre-test the LEDs. This will tell you which lead goes to the plus side of the battery. It will also tell you if you have the right size current-limit resistor. With too small a resistor, the LED will get quite bright and probably quit working. With too large a resistor, the LED will not give off enough light.

Speaker driver

The sound generator is on the top right side of the board. The smaller capacitors in it allowed a tighter layout. After you wire it, you can test it with anything from 1-1/2 to 9 volts. The loudness and the tone will change with the voltage. When you connect the battery, if it gives just a loud click in the speaker, remove the battery and recheck the wiring. A missing or wrong value resistor or capacitor can cause that problem, as can an incorrectly connected transistor.

Auto-Off switch

The Auto-Off switch is on the back left side of the board. The complementary output stage uses TIP series transistors because they give lower voltage drop than 2N3900 series transistors in this application.

To test the switch, you can connect a battery and a voltmeter—or better yet, one of the other circuits from the Box—to the collector of Q3 and battery minus. Battery plus goes to the collector of Q1 and the *emitter* of Q3.

If you have switch 1 wired you may push it, or momentarily connect C1 and

Parts List for Fig. 3, Auto-Off Switch

Part	Description	Radio Shack Number
R1	82 k–100 k	
R2	1 k	
R3	1500–3300	
C1	22–47 μF 6 V	272-1026, 272-1027
SW1	SPST pushbutton momentary contact	275-1547 red
SW2	SPST pushbutton momentary contact	275-1556 black
SW3	Single pole 6 or more positions	275-1385A
Q1	2N3904, 2N222A or similar transistor	276-1617
Q2	TIP31 NPN or similar power transistor	276-2017
Q3	TIP32 PNP or similar power transistor	276-2027 (*or* TIP42)

Parts List for Fig. 4, LED Driver

Part	Description	Radio Shack Number
R4	50 k or 100 k potentiometer	271-1716, 271-092
R5	2700–18 k	
R6	68–82 Ω	
R7	18 k–33 k	
R8	47–56 Ω	
C2, C3	22–47 μF, 47 μF typical	272-1026, 272-1027
Q4, Q5	2N3904, 2N222A or similar transistor	276-1617
LED1	Green LED	276-069
LED2	Red LED	276-068A

Parts List for Fig. 5, Sound Generator

Part	Description	Radio Shack Number
R9	100 k potentiometer	271-092
R10	10 k	
R11, R13	4700	
R12	15 k	
R14	15 k–22 k	
C4, C5,	0.05–0.1 μF 6 V or higher voltage	272-1068, 272-1069
Q6, Q7, Q8	2N3904, 2N222A or similar transistor	276-1617
SPKR	4–32 Ω	

(PARTS LIST CONTINUES)

Parts Lists. All lists include Radio Shack™ part numbers as a convenience. Equivalent parts will work.

Parts for Fig. 6, Meter Driver

R15	50 k or 100 k potentiometer	
R16	33 k	
R17, R22	4700 Typical value for 0–1 mA meter	
R18	120 k	
R19, R20	1500 Typical value for 0–1 mA meter	
R21	18 k Typical value for 0–1 mA meter	
R23	2200 Typical value for 0–1 mA meter	
C6, C7	22–47 µF 6V	272-1026, 272-1027
Q9, Q10, Q11	2N3904, 2N222A or similar transistor	276-1617
METER	0–1 mA	270-1754

Miscellaneous Parts

Knobs for switches and controls	274-415
Project box	270-223
Perfboard	276-1395, 276-1394
Double-sided tape	64-2343
Rubber feet	64-2346
Battery holder(s)	270-386 (2 D), 270-401 (1 AA), 270-385 (2 C)
Handles	available at any hardware store

the base of Q1 to battery plus. A voltmeter or the other circuit connected to the Q3 collector and battery minus should show that you have voltage. After a few minutes, the voltage should start to decay, that is, it should start dropping in value. A voltmeter will follow it all the way down.

Some of the circuits from the Box will drop out somewhere under 1 to 1-1/2 volts. If you wish to speed up the action, connect a resistor or a short across C1. A 10,000 (10 k) to 100,000 (100 k) ohm resistor will give an accelerated picture of the switch action. A short across C1 should turn off the switch without delay. The OFF push-button will turn off the system with a few milliseconds' delay because of the resistor in series with the switch. If someone pushes both buttons at the same time, it would place a dead short across the battery if you left out the resistor, R3 in **Fig. 3**.

Front panel

Photo B shows the finished product for this version. I did not include a front panel layout as you may want to leave off some of the functions used in Colby's Box. Possibly, you would find another layout more to your liking even if you used all of the same features.

Wiring notes

Once you decide what you want in your Box, pick up the parts, then drill the holes for the controls, the LEDs, the switches, etc. If you do use the meter, you may want to drill the holes for it first. The battery holder goes in the bottom of the box with the help of the thick, double-sided sticky tape.

After milling and drilling, mount the controls, the LEDs, the switches and lastly, the meter. You may find it more convenient to wire the various functions on the board before connecting any of them to the front panel controls. Wiring one circuit at a time and tying it to the front panel could strain the wires and your patience if they break. With the controls mounted, you can get a close guess as to the length of the wire needed to make the connection. That will leave just one slight problem: deciding which set of wires goes to which control. A close look at the photo will show what looks like Morse code on some of the wires. I used a marking pen—you may find more conventional wire markers more convenient.

Check out time

As I completed each function, I hooked a 3 V source to it and ran it through its paces. Then I marked the wires going to the front-panel control. With several functions, the wires make a fair-sized bundle. I intended to make them long enough so that they would dress along one side of the board. That makes it easier to put the board into the box without having to fight the wire bundle.

Continued on page 40

Continued from page 39

Since I have an adjustable voltage source, I could see how the various circuits worked with more than and less than normal voltage. More importantly, I could see if the circuits functioned in a more or less normal manner.

If one of the LEDs turns on and refuses to blink, look for a capacitor connected incorrectly, a misplaced resistor, wrong connections to a transistor, or the other LED hooked up backwards. These circuits are fairly simple and similar to each other. Once you get one of them working, you could copy the layout and use that for the other functions.

The sound generator is the simplest circuit, as it has no polarized parts. The capacitors in the sound generator may have either end connected to the collector, with the other end going to the base (of the other transistor). If you connect one of the electrolytic capacitors backwards in these circuits, you could get some unpredictable results. That could range from a dead circuit to the end blown out of the cap. Therefore, do pay attention to the wiring for the parts marked with a + (plus) and a - (minus) sign.

When you finish the wiring and the testing, put the batteries in their holder. With a marking pen, put the date on the batteries. That can give you a pleasant surprise the next time you have to open the Box. Then put the cover on and the screws in the cover. When you finish thoroughly "testing" all of the functions, let Junior have his or her turn at it.

Now that Junior is amusing himself with it, if you skipped the "how and why" section, you have time to go back and see what makes Colby's Do Something Box tick.

Two years after getting his Box, Colby is still entertained by it, as are his friends. If he ever outgrows it, he can use his Do Something Box as a conversation piece or a paperweight. Meanwhile, with the unit sitting on his dresser and set to the blinking LED feature, Colby can watch the lights while they slowly fade and he falls asleep thinking about his Do Something Box. 73

NEVER SAY DIE

Continued from page 8

you're certainly not going to send them to a public school. Or to most private schools, either. You're going to find a Sudbury Valley-type school or take up home education.

Paying For Pre-School

Day care with education instead of baby-farming is going to cost more. It's going to be out of the question for welfare mothers, lower income families, and many single-parent families. So who's going to pay? Why should someone with no kids have to pay to educate other people's children? Perhaps we should encourage people who can't afford to pay to bring them up not to have children. While that makes sense from a practical standpoint, the idea isn't going to get much support from the religions which promote having babies, whether their people can afford them or not. So let's not try to deal with reason, let's come to grips with the religious and emotional realities. We're going to have a lot of children who need education that the parents will be unable to afford. We know that the poorest people are having the most babies, so we know the load for supporting an educational program for them is going to rest more heavily on those with fewer children.

Instead of looking at kids as parental property, let's think of them as part of our infrastructure. These kids are just that. They're the work force of the future. They're the people who will have a fundamental effect on our American quality of life in the next century. If we ignore them we'll have more poor and more crime. Crime may make great movies and TV shows, but it sure hurts when it hits you personally. It's in our own common interest to invest in their early education.

So should we get started on a massive federal program to set up day care/pre-school centers? Should we invest hundreds of billions of dollars we have to borrow from Germany and Japan for this? Or should we set up state-run and financed centers? Well,

Continued on page 43

Number 41 on your Feedback card

EMTECH's NW40 Transceiver Kit

Another winner for QRP.

Jeff M. Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

Low-powered CW operation (QRP) has become increasingly more popular. Add the thrill of operating on a radio you built yourself, and it becomes easy to get hooked on this aspect of the hobby. The problem with building your own equipment comes mostly on the operating side of the venture.

It is very easy to build a simple transmitter or a simple receiver. If you find the performance of the gear you built to be poor, you will soon lose interest after the initial "high" of a contact or two. On the other hand, if you build a transceiver that can pull in the signals, is easy to operate, has a stable receiver, and provides good transmit/receive switching, you are much more likely to stay interested in QRP—and ham radio.

A number of excellent kits have become available recently at very reasonable prices. I try at every opportunity to get new ham radio operators interested in CW by encouraging them to get on the air as soon as they learn the Morse code basics. I can't think of a better way to keep interest in the code requirement than building a piece of equipment and getting on the air regularly as your method of practice.

When my son was seven years old, as soon as he learned the basic code letters, numbers, and a couple of punctuation marks, I sat with him once a night while he made a contact. It didn't take him long to bring his speed up to 13 wpm, and then to 20 wpm. He managed to pass his General license before his eighth birthday. Many hams I have talked with see the code requirement as a specific torture geared at preventing them from getting their General or above ticket. If you change the frame of reference from "I have to do this undesirable, difficult task, that I most likely will not succeed at" to "I just built this really neat little radio that I can power from a battery and talk to people all over the world with," it really does a lot to change the attitude and motivation.

After building and testing the EMTECH NW40, designed by Roy Gregson W6EMT, I would have to say it ranks at the very top of kits for either a beginning kit builder or anyone of any experience who likes to build. The kit is easy to construct and works beautifully when completed. My initial test for this radio was on Field Day 1997, which I considered trial by fire. Luckily I did not encounter any smoke-related incidents while building the kit. The rig is small and lightweight. It makes a great backpacking radio, and seems to feel very much at home in my shack. Though I have many rigs in my ham shack, I tend to use just a few regularly, and I find I use the NW40 all the time. I think I had as much fun building this kit as I am having using it.

The NW series incorporates a superhet single signal receiver with a variable bandwidth crystal filter and a two-pole active audio filter (from the *ARRL Handbook*). What this means to me is that the radio works very well at getting wanted signals heard by you even if they are weak. It also means having the ability to block out nearby unwanted signals.

The kit is available for 80, 40, 30, and 20 meters. The EMTECH NW40, not surprisingly, is for 40 meters. I have also built and tested the design on 20 meters and it worked equally well. The cabinet features painted and silk-screened front and rear panels and comes with all necessary hardware. I really like the professional look of the cabinet kit—it's lightweight but sturdy. I also appreciated not having to hunt around for all the necessary connectors. Drilling holes in cabinets has never been one of my best skills.

The radio tunes more than the advertised 7.000–7.2000. This is a great feature for a Novice operator. You can build the kit, operate on the Novice portion of 40 meters, or listen to SSB. As you upgrade your license, you will already

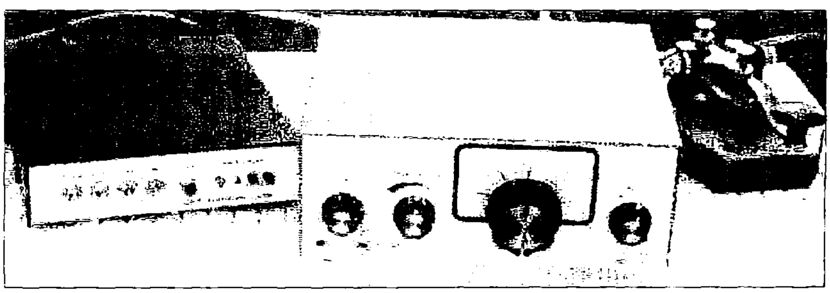


Photo A. *The EMTECH NW40 joins an LDG QRP autotuner for Field Day 1997.*

have the ability to work that portion of the band.

I also found the receiver to work exceptionally well. I haven't found any drift problems. I really like the tone of the radio and it will drive a five-inch speaker. There's a front panel adjustment for volume. I don't turn up the audio level much. Many kits have front panel RF control but I have usually found that once I set the RF level, I almost never touch the control again—but I sometimes wish that the radio had a volume control. I was pleased to see this feature incorporated in the NW40 kit design. The radio has receive incremental tuning (RIT). This is another useful operating feature, especially in noisy or crowded band conditions.

The NW40 has solid-state true QSK. This means that you can hear signals between your dits and dahs even at 20 wpm, just as with the expensive commercial rigs. The sidetone is derived from the transmitted signal. You can adjust the level to suit your preferences with a simple internal adjustment. I found the switching to be smooth, without any clicks or other annoying features. My rig initially put out a little over seven watts, but it is internally adjustable to the mW range. I operate mine a little shy of five watts, to stay in the QRP range classification.

Building the kit

The NW series are first-line kits. The parts are all good quality. The printed circuit board (PCB) is one of the nicest I have ever worked on. It has excellent silk-screening and plenty of room on the board, making correct parts placement a lot easier. The silk-screen even has clear markings for the legs of the transistors (C-B-E, D-G-S), which is very helpful for checking voltages and locating problems. The bottom side of the board is solder-masked to help prevent the leading cause of kit-building problems: solder bridges.

Photo B. Avery Ashby KE4ERW, member of the Tennessee Technological and Amateur Radio Society, gets ready for a contact.

One of the aspects I appreciated most about the kit was that you build a section at a time and then test it. I find that this approach maximizes the probability that you will be successful. I think beginning builders will find this especially helpful. To help even further in making building this rig a truly enjoyable experience, the parts for each section are packaged separately.

The part I like least about building kits occurs before I start soldering. This is separating out and labeling the parts. With each section individually packaged, I found I could dump the parts in a small plastic container and then easily pick out the parts as I needed them. The only exception to this is the "band pack," which has those components needed to build the kit for each of the bands.

To build the kit, you will need a 15–30 watt soldering iron. I suggest having some desoldering braid around. If you put a part in the wrong spot on the board, this will make it very easy to remove the part without damaging the board or the component. To align and test the kit you will need minimal test equipment, a VOM, and a calibrated station receiver or transceiver. It is helpful to have a frequency counter, wattmeter, and oscilloscope, but they aren't essential.

The manual is great—clear explanations of component markings that make it easy to identify them, detailed drawings for component identification, and blowups for each section you build. The blowups are very helpful. There are also enlarged diagrams for the final wiring sections. I really appreciated the two-page section in the manual that gave resistances and voltages for the transistors and ICs. I found the directions to be complete and easy to follow. I had *no* surprises caused by the manual.

The first steps for building the kit tell you how to wind the toroids. Some beginning builders get nervous when they first encounter this. The directions will lead you through the steps and you shouldn't have any problems. Make sure while building that you highlight the band you are working with so that you wind the coils for the correct one.

Also, be careful in checking the "Band Table" below to ensure that you handle the transformers properly.

Tuning Ranges	
80 meters	3.500–3.750
40 meters	7.000–7.200
30 meters	10.100–10.135
20 meters	14.000–14.070

For 20 and 30 meters you will be required to break a small internal capacitor on the bottom of the transformer. I highlighted the information for the band I was building and read the information twice before proceeding.

After winding the toroidal coil, you will build and check the VFO. You next build and check the keying circuit, the RIT circuit, the audio amplifier, and then the receiver.

Each section is fairly compact and doesn't require too many parts. This is helpful for the beginner as well as the experienced builder. It divides the project up into easily managed sections and gives the builder a feeling of accomplishment. At this point, you build the optional meter circuit. The parts are included with the kit (I chose not to build it).

You next proceed to the transmitter section and then test it without the final transistor in place. Once you are confident that the transmitter is working correctly, you add the final transistor.

The final adjustments involve setting the BFO, centering the RIT, and setting the VFO range. Once this is accomplished, you set the transmitter level and adjust the sidetone. I found the adjustments to be very straightforward and easy to do. If you have a problem there is a page on troubleshooting as well as the two pages on voltages and resistances.

The audio filter (AF1) is a very small board with a low parts count (17). You can select the filter bandwidth by selecting pairs of resistors. Resistors for each bandwidth are provided. The two bandwidths are 750 Hz and 650 Hz. There is also a set of resistors for changing the audio gain. I used the suggested values and am very pleased with the results.

On the 20-meter version, I experimented with all the values. I suggest using the recommended values. Once you have completely checked out the operation of the rig, go ahead and experiment.

The bottom line is that this was one of the most fun kits I have had the pleasure

to build. The care EMTECH took in planning the instructions and the parts packaging really made it enjoyable.

Operating the NW40

After I assembled and aligned the rig, and long before it found its new home in a stylish case, I was impressed with the receiver. Sitting before the wooden table of my workbench, I powered up the rig on it. This was one of the few times I have not been anxious about smoking parts. Since I had tested each section as I built, I was confident that the worst problems I might encounter would be small. On power-up with no antenna, I was still pulling in signal fairly clearly. I wrapped the board with all the controls hanging off it and brought it over to the operating bench, connected my antenna and hooked up a battery. The band was pretty noisy so I turned on the audio filter. The filter does a great job in cutting out band noise. I tuned around and heard WQ4L. I was able to work John in Mount Vernon VA. I then worked Arn KK4VH, in Portsmouth VA.

I needed to leave the project for a while. The day before Field Day I got the rig in the case and it was ready to go. No time for further testing before the big day. For Field Day I hooked up a G5RV between two trees up at about 25 feet. I hooked the NW40 to my little LDG autotuner and a 4 Ah gel cell and my straight key (last used during my Novice days).

I had no problem working most contacts, except if there were many stations all on the same frequency. The receiver was able to stand up to the crowded band, and with the bandwidth set at about the middle position I found that the rig really held its own. We worked over 200 contacts with the little gem with only a couple of operators and not much operating time on the air. We blew away the remaining club workers who were operating SSB using a commercial 100 watt rig and resonant dipoles. Obviously, the NW40 is a quality transceiver and you can expect to get plenty of use out of it if you build it properly.

For $130, including the audio filter, case kit, and shipping, you get a quality radio that is fun to both build and operate. For further information, contact EMTECH, 3641A Preble St., Bremerton WA 98312; (360) 415-0804.

NEVER SAY DIE

Continued from page 40

we know that public schools tend to cost at least twice as much to run as private schools, so let's not consider federal or state-run institutions. I'm suggesting the use of state-collected money to pay for private centers. The old voucher system.

But who's going to control these centers? Don't we need state accreditation, complete with more state inspectors and administrators? Absolutely not! This is a big part of the problem we have today, and certainly is not a part of the solution. I would go along with the state setting up an information service, complete with a newsletter for parents. This group would inspect the centers and report on them. From there on it'd be up to the parents to take action.

If I were doing it I'd make the whole operation self-funding by charging for advertising in the newsletter, plus charge nominally for subscriptions. Parents unable to afford say $10 a year for a newsletter could read it in their local libraries. What advertisers? How about the makers of educational toys? How about the publishers of children's books? Children's videos and cassettes? Children's clothes? The revenues from these firms should easily support investigative teams to visit centers and report on them, plus get input from the parents who take the time to help the day-care centers.

Are you critical of me for thinking in terms of publications to help solve problems? Publications happen to be one of the best ways of distributing information.

I tend to think in entrepreneurial terms—of making publications at least not lose money. I believe in the fundamentals of capitalism. I believe in making our state governments as capitalistic as we can instead of trying to run them on the socialistic system, which has failed in every country where it's been tried. So I tend to want to privatize as much of our federal, state and local government activities as possible. They'll cost us the least that way and we'll tend to get far better service.

I admit that the capitalistic system is not working well with Congress. Gore Vidal isn't completely wrong in his estimation that the international megacorporations and big unions with their lobbies have bought our government. This situation could be improved with a publication which would expose which members of Congress have gotten money from which lobbyists, and what legislation has resulted. If we had a publication which informed the public, the media, and potential candidates on these matters, it might act as a deterrent.

I remember when *US News* did an exposé on Senator Bentsen, showing what payoffs he'd gotten in return for tax breaks for large corporations. The formula seemed to be about one dollar in his kitty for every thousand in tax breaks he was able to put through for these special interests. Just the kind of guy we needed for vice president, right?

The information is public, if you fight hard enough to get it. So let's throw the light

Continued on page 45

Special Events

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the February 1998 issue, we should receive it by November 30. Provide a clear, concise summary of the essential details about your Special Event.

NOV 1

ENID, OK The Enid Hamfest Group will sponsor the Enid Hamfest, 8 a.m.–5 p.m. at the Garfield County Fairgrounds (Hoover Bldg.), at Oxford & 4th Streets. Adm. $2; tables $1 each. VE Exams at 1 p.m. Free covered dish banquet at 7 p.m. Contact *Tom Worth N5LWT, (405) 233-8473* or *Fred Selfridge N5QJX, (405) 242-3551*. Talk-in on 147.15(+) and 444.40(+).

MILWAUKEE, WI The Milwaukee Repeater Club will sponsor the 13th annual "6.91 Friendly Fest" 8 a.m.–1 p.m. at the Waukesha County Expo Center Arena Forum, N1 W24848 Northview Rd., in Waukesha WI. Setup at 5:30 a.m. Tickets $5; 4' tables $5. Please call *Burt N9VBI, (414) 328-0535*. Send SASE with payment to *The Milwaukee Repeater Club, P.O. Box 2123, Milwaukee WI 53201. Web [http://www.execpc.com/~mrc/friendlyfest.htm]*. On-site VE exams. Talk-in on 146.91(-) (The Friendly Repeater), and on 146.52.

WATERFORD, CT The Tri-City ARC of Groton CT will host its 7th annual Fall Auction at the Senior Citizens Center, Waterford Municipal Complex (Rt. 85, south of Exit 77 of I-395, or north of Exit 82 of I-95). Setup starts at 9 a.m. The auction will be held from 10 a.m. until sold out. Adm. is free and food will be available. Wheelchair access. Bring your equipment to be auctioned. Talk-in on 146.37/.97 rptr. For more info call *KA1BB at (860) 739-8016*.

NOV 2

KAUKAUNA, WI The Fox Cities ARC annual Hamfest will be held at the Starlite Club, corners of Hwy 55 and Cty. Road 11. Advance tickets $4 each, 8' tables $8 each. You must buy an adm. ticket if you pre-register. Send check or money order payable to *FCARC, 1912 Russet Ct., Appleton WI 54914; Attn: Chad Pennings N9PRC, Hamfest Chairman; Tel. (414) 993-0485*. Talk-in on 146.52 simplex. Register for VE exams at 8 a.m.; testing starts at 9 a.m. No walk-ins after 9 a.m. Bring original license plus 2 copies, and a photo ID. For more exam info, contact *Larry Siebers KD9IA, (414) 757-1167*. Nearby lodging.

NOV 8

MONTGOMERY, AL The Montgomery ARC will host the 1997 Alabama ARRL State Convention and the 20th annual Montgomery Hamfest and Computer Show in Garrett Coliseum at the South Alabama State Fair grounds located on Federal Drive in the NE section of historic Montgomery. Adm. $5, free parking, all indoors including the flea market. Setup 3 p.m.–8 p.m. Fri., Nov. 7th; and 6 a.m.–7:30 a.m., Sat., Nov. 8th. Doors open to the public 8 a.m.–5 p.m. CST. VE exams on site beginning at 8 a.m. Bring original and a copy of your current license, picture ID and $3. Talk-in on 146.24/.84, call W4AP. Rag-chew 146.32/.92 (with phone patch, *up/#down), 147.78/.18, and 449.50/444.50. Flea market reservations are encouraged. Kickoff banquet Fri. evening at Bonnie Crest Country Club, with ARRL national staffer Rick Palm K1CE. Contact *Patty at (334) 567-7195*, or *E-mail to [prolan@juno.com]* for reservations. ARRL QSL card verification for all awards (WAS, DXCC, etc.) on site. For more info or table reservations, write to *Hamfest Committee, c/o 2141 Edinburgh Dr., Montgomery AL 36116-1313;* or phone *Phil at (334) 272-7980 after 5 p.m. Fax (334) 365-0558;* or E-Mail *[WB4OZN@worldnet.att.net]*.

NOV 15–16

FORT WAYNE, IN The Fort Wayne Hamfest & Computer Expo (including the Indiana ARRL Convention), sponsored by the Allen County Amateur Radio Technical Soc., will be held at the Allen County War Memorial Coliseum and Exposition Center, at the corner of Indiana 930 (Coliseum Blvd.) and Parnell Ave. Doors open for dealer setup Fri. eve. and Sat. morning. Open to the public 9 a.m.–4 p.m. on Sat. and 9 a.m.–3 p.m. on Sun. Features include: Flea market, new and used radios, computer and general electronics, forums, meetings; with VE exams on Sat. Coliseum parking is $2 per vehicle. Adm. $5 (children under 12 free with an adult). No advance ticket sales. Talk-in on 146.88(-). Tables are available for $15 each (flea market) and $30 (premium). Electricity $25 per vendor. To order tables or request info, send an SASE to *ACARTS, P.O. Box 10342, Fort Wayne IN 46851*. For general info, call *Doug Jones, (219) 484-1314;* or for table info call *Bill Anders, (219) 483-8163*.

NOV 21–22

OCEAN SPRINGS, MS The West Jackson County ARC will hold its annual Hamfest/Swapfest at the Latimer Community Center north of Ocean Springs. The hamfest will be open to the general public 4:30 p.m.–9 p.m. on the 21st; and 8 a.m.–3 p.m. on the 22nd. Adm. is $2 per adult, or $4 for an entire family. The Latimer Community Center is located approx. 4 miles north of I-10 exit 50. Ample parking is available at the Community Center. Completely self-contained RVs may park overnight. There are several motels in the vicinity of Exit 50. 8' sales/swap tables $5 each. Advance deposits are required for sales table reservations. Talk-in on 145.110 MHz (-600). The frequency will be manned from 12 noon on the 21st until the hamfest ends on the 22nd. Contact *Harry McLemore KD4AK, (601) 872-0732*, or *Stan Hecker N5SP, (601) 875-0222*. Send written correspondence regarding the hamfest to *West Jackson County ARC, Inc., P.O. Box 1822, Ocean Springs MS 39564*.

NOV 22

NEWTONVILLE, MA The Waltham ARA and the 1200 Radio Club will co-sponsor an Amateur Radio and Electronics Auction. 11 a.m.–4 p.m. at Newton Masonic Hall, 2nd floor, 460 Newtonville Ave., at the corner of Walnut St., in Newtonville MA. Adm. $2. Free parking in the municipal lot across Walnut St. Please do not park in the lot next to the Masonic Hall, nor in the Star Market parking lot. If you are selling, please label your equip. with a brief description and state its condition. Include your call and name on the label. Bag small items. Don't bring junk (TVs, boat anchors, non-electronic items, etc.) Commission 15%; $1 minimum; $30 maximum; $0 for owner buy-back. For more info, contact *Eliot Mayer W1MJ* at *(508) 664-0773; E-mail [w1mj@amsat.org]*. Check the auction Web page at *[http://ourworld.compuserve.com/homepages/emayer/auction.htm]*. Talk-in on the 146.64(-) Waltham rptr. WARA and 1200 RC thank the Newton Masonic Associates for the use of their fine facility.

DEC 7

HAZEL PARK, MI The Hazel Park ARC will hold their 32nd annual Swap and Shop 8 a.m.–2 p.m., at Hazel Park High School, 23400 Hughes St., Hazel Park MI. General adm. $5 advance or at the door. Tables $14 each. Reservations must be received with check, no reservations by phone. Plenty of free parking. Talk-in on 146.64(-) (DART). Swap info, tables, and ticket reservations to *HPARC, Box 368, Hazel Park MI 48030*.

JAN 17

ST. JOSEPH, MO The 8th annual Northwest Missouri Winter Hamfest will be held on Jan 17th, 1998, 9 a.m.–4 p.m. at the Ramada Inn in St. Joseph MO, with special room rates for Hamfest participants. The event is being co-sponsored by the Missouri Valley ARC, Green-Hills ARC and Ray-Clay ARC. The motel is located at I-29 and Frederick Ave. (exit 47 on I-29). Talk-in on 146.85 and 444.925. VE exams, major exhibitors and flea market all indoors. Free parking. Advance tickets $2 ea. or 3/$5; at the door $3 ea. or 2/$5. Pre-reg. requests received after Jan. 8th will be held at the door. Swap tables $9 ea. first 2 tables. Commercial exhibitors welcome. Write for details to *Northwest Missouri Winter Hamfest, c/o Gayien Pearson WBØW, 1210 Midyett Road, St. Joseph MO 64506*.

SPECIAL EVENT STATIONS

OCT 28–NOV 2

ST. CHARLES, IL Unity Lodge #48 AF & AM of St. Charles, IL will operate N9FWM 0100 UTC Oct. 28th–2300 UTC Nov. 2nd, to celebrate their 150th year. N9FWM will operate SSB alternately on 28.400, 14.250, 7.150 and 3.980.

For a certificate, send QSL and a 9" x 12" SASE for unfolded or #10 SASE for folded, to *N9FWM, 38W248 Joan Dr., St. Charles IL 60175 USA.*

OCT 31–NOV 1

BREVARD, NC The Translyvania County ARC (KE4ZIS) will sponsor their 9th annual "Halloween Fest" at the Devil's Courthouse, located on the famous Blue Ridge Parkway in Brevard. The station will be on the air 1800 GMT Oct. 31st–0200 GMT Nov. 1st. Frequencies: 7.237, 14.295, 21.305, 28.335, 146.25 MHz (+/- 10 kHz for QRM). Certificate available with large SASE to *TCARC, P.O. Box 643, Brevard NC 28712 USA.*

NOV 4–11

GUELPH, ONTARIO, CANADA The Guelph ARC will operate VG3W from the birthplace of Col. John McCrea, WWI surgeon and poet, author of *In Flanders Fields*. Local school children may use the station to send messages of peace and goodwill. Operation will be from 1400Z–2100Z Nov. 4th to Nov. 11th, on 80 meters and 6 meters. For a QSL, send QSL and SASE to *Scott W. Smith, 296 Elizabeth St., Guelph, ON, Canada N1E 2X7.*

DEC 12–13

BETHLEHEM, IN The Clark County ARC will operate W9WWI, 1500Z Dec. 12th–2200Z Dec. 13th in celebration of the Christmas Season. Operation will be on General 75, 40 and 20 meters. QSL with an SASE for a certificate, to *CCARC, 1805 E. 8th St., Jeffersonville IN 47130 USA.*

JAN 10–11

1998 HUNTING LIONS IN THE AIR CONTEST The 26th annual Hunting Lions in the Air Contest will take place 0900 UTC Sat., Jan. 10th–2100 UTC Sun., Jan. 11th, with the objective to create and foster a spirit of international understanding and cooperation among amateurs and Lions, through worldwide communication. The contest is to commemorate the birthday of the founder of Lionism, Melvin Jones, born at Ft. Thomas AZ, USA, on Jan. 13th, 1879. Operators interested in additional info regarding this contest should write to *Contest Committee, Lions Club Flen, Box 106, 642 23 Flen, Sweden. E-mail [goran.blumentahl@swipnet.se].* 73

Never Say Die

Continued from page 43

of day on these things. I can't think of any advertisers for such a publication, but I'll bet it could easily make a profit just on subscriptions. A couple thousand newspapers would want it, plus who knows how many potential Congressmen interested in upsetting incumbents. It should sell well.

It would be interesting to show how much foolish legislation Waxman (Hollywood) has introduced to support the movie and record industries' giant corporations. And also how much Gore (Nashville), while a senator, proposed for the record industry. As the Washington insiders keep telling us, it's so much worse than you think, that you can't even imagine how bad it is. Having been deeply involved with the record industry, I had a first hand opportunity to watch the sleazy work done by Waxman and Gore. Yes, I was down there in Washington, testifying fruitlessly before Congressional hearings.

The bottom line is that I propose we plan to pay for pre-school education by having our states collect the money and make it available in voucher form for parents. If we manage to keep the state and federal governments out of running or controlling the schools we'll keep our costs to a minimum. I'd like to see the states organize a profit-making information publication for parents as the controlling system.

How we should collect the money for this is another story. I have some ideas on this, but this isn't the best place to go into the details. That's a whole 'nother story in itself. Do we want an income tax, property taxes, sales taxes, or what? Each has pluses and minuses. And since most tax approaches have aims other than just plain revenue collecting, that'll be an interesting subject to discuss.

Mea Culpa

I hope the above will help some of you. Oh, how I wish I'd known about all this before I had my children. They could have turned out a lot different. Alas, becoming a parent is both fun and easy, with no knowledge or licensing required. Our schools don't teach our kids about having kids, and finding the right books is very difficult. Please

Continued on page 70

A Baycom-Style HF PSK Modem

Build a packet modem from scratch.

Austen Harris VK4TN
c/o Gold Coast Amateur Radio Society, Inc.
P.O. Box 588
Southport QLD 4215
Australia

PSK packet? What the hell is PSK packet, you might ask? Well, for a start, PSK stands for Phase Shift Keying. PSK has quite a lot going for it, especially when you want to run high-speed traffic on a reliable path. 1200 baud on HF isn't a problem at all. Faster baud rates are quite possible.

Our first introduction to PSK packet came about when the QDG (Queensland Digital Group) asked us to consider setting up a PSK link to VK7 as a message forward station. As VK4WIG BBS had been set up as a club BBS within our club rooms, it was thought that we would be able to draw upon our resources to make the link a going thing.

A subcommittee was formed to investigate the possibility of such a setup. A crystal-locked transceiver was lent to the club by Ed VK4JEN for our tests on 14 MHz. A TNC, modified for PSK use, was sent down from QDG for our test.

OK, what have we got? we asked ourselves. Not knowing a thing about PSK packet we had a lot of questions to ask. The thing that stood out the most was the fact that not too many others really understood PSK either. We were faced with a steep learning curve, to say the least! Then along came Doug VK4ZDR. He had been instrumental in setting up the PSK radio links for NASA during the '60s and '70s, and he is a member of our club. He is also a co-sysop for our BBS VK4WIG.

Our resources had grown at a great rate. All we had to do was put it together—when it all went sour. We did put the setup together after we were able to find out what frequency to set the rig on. Peter VK4XPD got hold of a crystal that would let us work the frequency and tune the rig to it. The commands for the TNC were finally sorted out, and after a couple of weeks we finally connected to VK7BBS. We thought we had it made. A few more tests were done and then disaster ... the TNC died!

What to do now? we asked ourselves. We didn't have another TNC modified for PSK use. What do we have to do to modify another TNC? Then we came across the G3RUH design for a PSK modem used for satellite use in conjunction with a TNC, which turns out to be the basic setup in the TNC we had. A copy of the G3RUH modem setup was given to all concerned to evaluate whether we could use it with any other TNC. Our options were diminishing at this stage.

As VK4WIG was running with Baycom-style modems at the time, we considered that there wasn't a great need to persist with a TNC-based PSK setup. Now we had our work to do, to design a Baycom-style PSK modem that would run into an FBB-based BBS along with the other modems already in use.

The basic concept for the design revolved around the G3RUH design, but utilizing the principles as if it were a Baycom modem feeding the computer. The original design simply replaced the TCM3105 chip pins as in a Baycom modem setup. A PCB was laid out to include the basic G3RUH design for his terrestrial use and feed into a Baycom board. Initial tests were done on 2m between our two local stations, VK4AOC and VK4TN. After we sorted out the filter restrictions that the rigs imposed upon us, it worked out well.

The next step took a while to finalize. As we had found out quite a while ago,

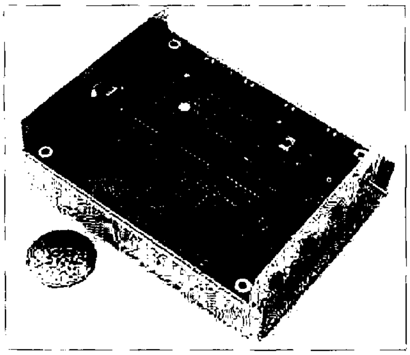


***Photo A.** Top view shows handy size of PSK Modem.*

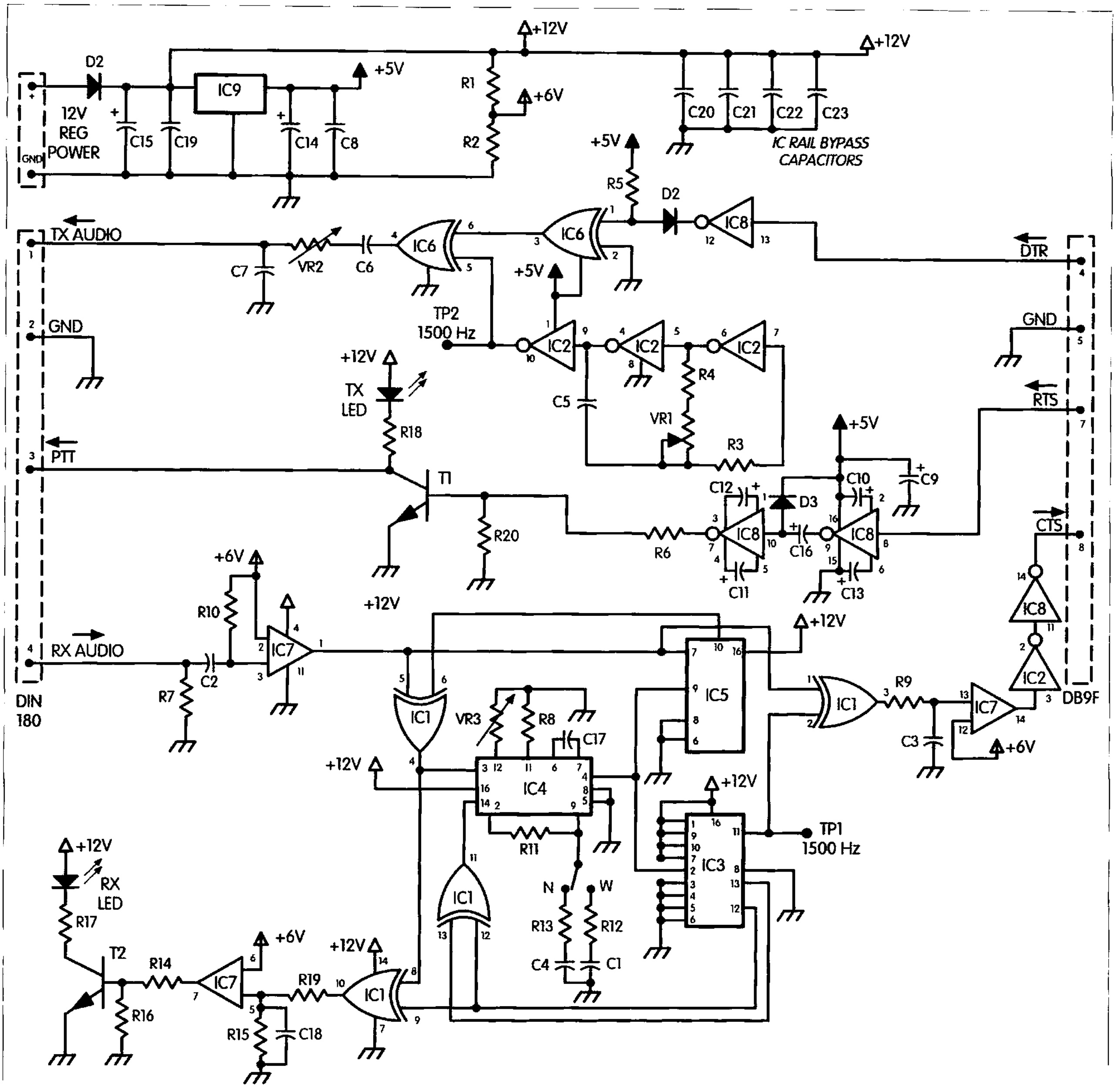


***Fig. 1.** Schematic diagram of the Baycom-style HF PSK Modem.*

the original Baycom modem fed the computer via a 74HC04 chip, which meant a pseudo RS-232 level was presented to the serial port. This caused problems with reliable operation. We are at present driving our serial port via MAX232 chips which deliver a standard RS-232 level—no more problems!

The next problem to overcome was to provide a stable 1500 Hz TTL level signal to feed the TX modulator as described in G3RUH's article. He had suggested that a frequency somewhere between 1400 Hz and 1600 Hz would do the job. Our selection seemed to work out quite well, but it drifted. That problem was solved by the introduction of a low-drift capacitor in the circuit. A .01 µF J polyester with a 120 ppm/deg C was our choice. All our tests on the oscillator have shown a high degree of stability, running weeks at a time with a 1 Hz drift.

We also required a timeout circuit to be incorporated with the design and the two spare inverters within the MAX232 were pressed into operation for that. TX and RX LEDs were also required. The TX LED wasn't a problem at all, but the RX LED required a bit of thought. It finally turned out to be the "Lock" indicator LED in G3RUH's setup.

A prototype PCB was laid out and built. Tests carried out provided instant success with connections to VK7, VK2, VK5 *and* VK4 stations.

Circuit description

The circuit can be broken down into five parts consisting of:

1. The TX modulator.
2. The RX demodulator.
3. The timeout and PTT circuit.
4. The RX LED circuit.
5. The power supply.

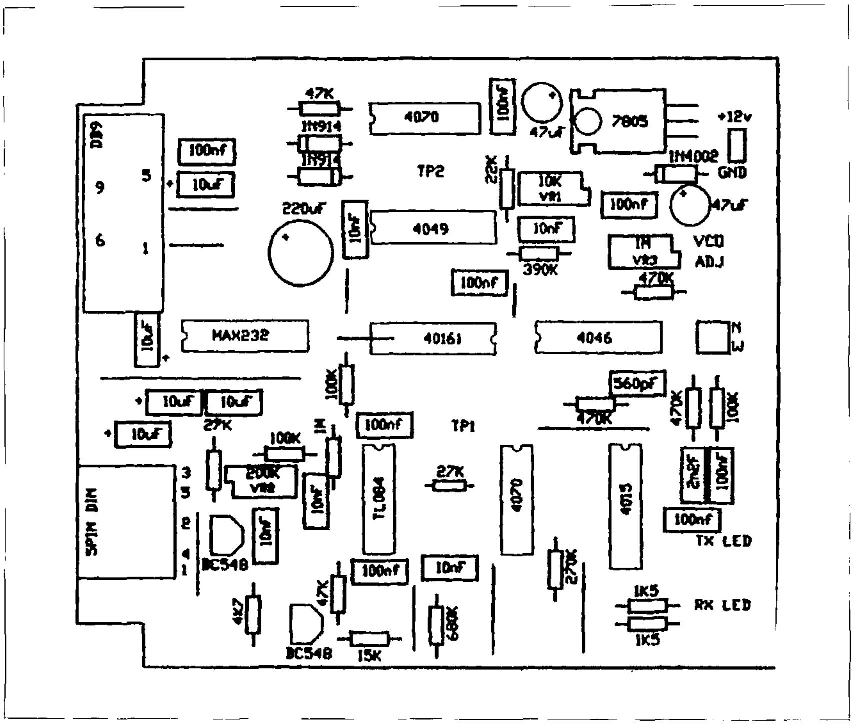


Fig. 2. Parts placement diagram for the PSK modem.

TX modulator

The data from the computer is fed to a MAX232 gate which inverts and sets an RS-232 level in case of long leads. This in turn is fed to the 4070 exclusive-ORed gate. The output of that gate feeds another 4070 gate which is also fed by our 1500 Hz oscillator. The output of this gate is the result of our combination and is coupled to the audio input of the radio. What we have as a result is PSK-modulated audio. The level of audio is set with VR2 and the 1500 Hz is set via VR1 and tested on TP2. Please note that C5 is a high-stability-type polyester. e.g.."J" (120 ppm/deg. C.) or better.

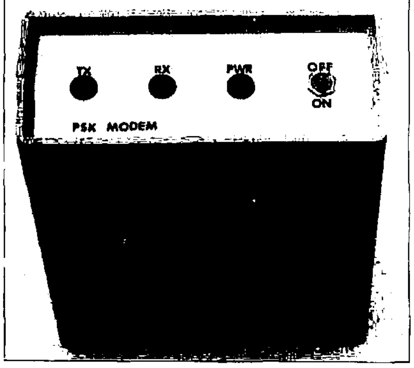


Photo B. Front panel view.

RX demodulator

Apart from our inclusion of a MAX232 gate, this is part of the circuit that G3RUH described for his JAS-1 satellite modem. It's extremely easy to set up—all you have to do is adjust VR3 to obtain a 1500 Hz signal on TP1. You can choose two bandwidth settings, 20 Hz and 100 Hz. We have found 100 Hz to be the best so far. Please note that C17 should be a polystyrene.

Timeout and PTT circuit

Because we wanted to include a TX timeout circuit, we had to decide which chip to use. Because of board location, the MAX232 spare gates won the job. C16 and the internal pull-up resistor in the gate set the timeout to approximately 22 seconds. A simple NPN transistor is used to switch our PTT line LOW as well as drive an LED as the TX indicator.

RX LED circuit

This part of the project was once again described in G3RUH's satellite modem, but as a lock indicator. The only thing that has changed is the value of R15 from a 750 k to a 680 k. It gave a better indication of LOCK when using this modem on HF.

Parts List

A1	5 pin DIN
A2	DB 9/F
A3	IDC2 2-way header pin
A4	IDC4 4-way header pin
C1	.0022 µF Mylar™ or polyester
C2, C3, C6, C7	.01 µF Mylar or polyester
C4, C8	.10 µF Mylar or polyester
C5	.01 µF J polyester
C9–C13	10 µF tantalum
C14, C15	47 µF electrolytic
C16	220 µF electrolytic
C17	560 pF polystyrene
C18–C23	.10 µF monolithic or disc ceramic
D1	1N4002
D2, D3	1N914
IC1, IC6	4070
IC2	4049
IC3	40161
IC4	4046
IC5	4015
IC7	TL084
IC8	MAX232
IC9	7805
R1, R2, R13	100 k
R3	390 k
R4	22 k
R5, R14	47 k
R6, R9	27 k
R7	4.7 k
R8, R11, R12	470 k

(Parts List Continues)

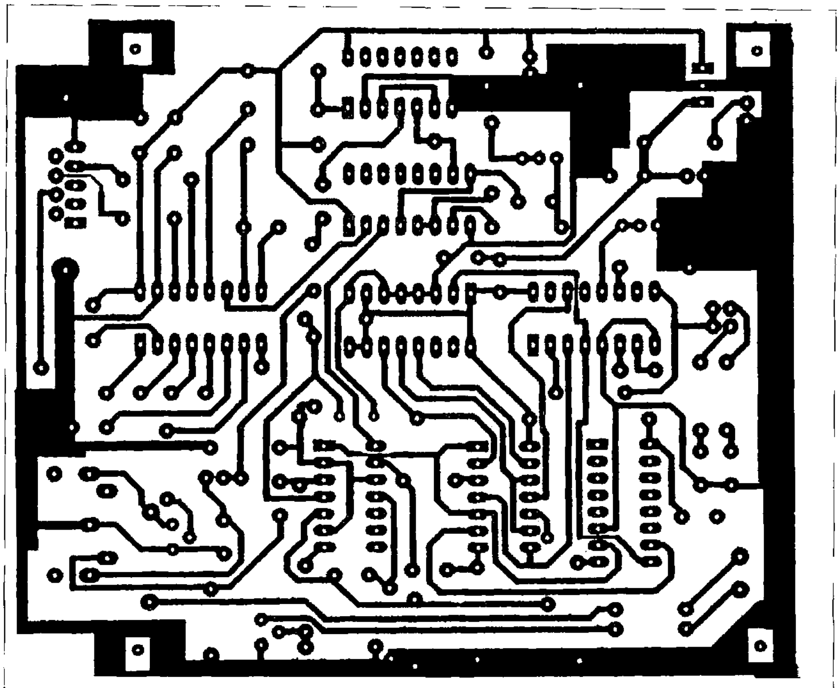


Fig. 3. PSK Modem circuit board layout, component side view.

Power supply

12 VDC is used to feed the modem, but we did have to provide 5 VDC and 6 VDC as well. A three-terminal 5 V regulator has been employed, along with a simple resistor divider to obtain the 6 V line. Total current consumption is well under 100 mA.

Parts List (continued)	
R10	1 M
R15	680 k
R16	15 k
R17, R18	1.5 k
R19	270 k
R20	15 k
T1, T2	BC548
VR1	10 k multiturn
VR2	200 k multiturn
VR3	1 M multiturn
All resistors 1/4 W	

Table 1. Total components = 64.

Please note that a well-regulated supply should be used.

Construction

To keep the project as neat as possible, the whole unit has been laid out on a PCB to fit in a standard kit-size box available at most electronic stores. The only components not mounted on the PCB are the LEDs, power input socket, and an ON/OFF switch. We decided to use IC sockets in our first unit, but they aren't necessary if you wish to omit them. They can save you a few problems, though, if you happen to have done something wrong when loading the board!

Remember to check your voltages around the board first before loading the ICs. Double-check the IC layout (e.g., location of pins). Make sure you use a high-stability cap for C5 in the 1500 Hz oscillator. The higher the stability, the better. Use multiturn pots to make the setup dead easy and save a few follicles from hitting the floor. Also remember to put the jumpers onto the board *first*. There is one jumper required to go under the 40161 which can be missed out.

Alignment

You will need access to a frequency counter for the setup of the modem. First, set TP2 to 1500 Hz by adjusting VR1. Next, set TP1 to 1500 Hz by adjusting VR3. VR2 is set about halfway for the TX audio input and can be adjusted to suit the rig being used. The RX audio input can be fed straight out of any SSB transceiver extension speaker output. Tune in to a PSK station until you see the RX LED on the modem light. You may find that on some transceivers the signal has to be fairly strong before you resolve anything at all. It is possible that the audio filters after the product detector are causing the problem. In that case, a simple tap-off prior to the product detector with a small amp may be in order. Most commercial rigs used for data do this. I am using a Yaesu FT-102 at my QTH on 14 MHz with a tap-off from the product detector to an external jack. Austen (Ausie) VK4TN uses a TS- 520S with an external speaker jack as his RX audio source.

Comments

This project has been a challenge to all of us here at the Gold Coast Radio Club involved in packet and general RF techniques. One thing that has stood out during the development of the project has been the spirit of amateur radio, and the helpfulness of the members that were interested. We personally would like to give credit to those who participated in the project. Thanks, guys!

PC boards for the HF PSK Modem are available at a cost of $45 AUS or $36 US. The boards are professionally made and of a high quality. Postage is included for Australia; add $5 AUS or $4 US for overseas. All inquiries should be sent to: Gold Coast Amateur Radio Society, Inc., P.O. Box 588, Southport, QLD 4215, Australia.

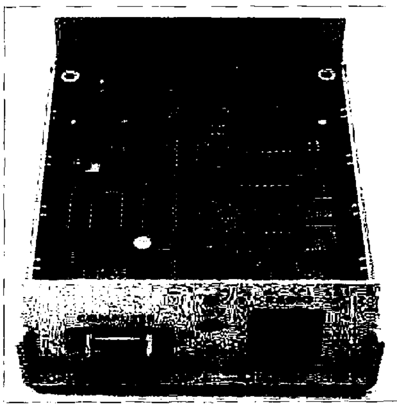


Photo C. Rear view shows external connections.

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041-0099
[carrjj@aol.com]

Builder's potpourri

One of my passions for many, many years has been building electronics projects. Although I have several types of circuit modeling software that allows me to scope things out before going to the bench, I still like to do a little experimenting ("cut 'n' try") on the workbench. Of course, the software allows me to get closer to the goal, but I still like to heat up the old soldering iron. This month, let's take a look at some issues that affect amateur electronic and radio constructors ... especially those who do radio frequency (RF) projects.

Mounting printed circuit boards

Most projects today are built on either perforated circuit board (perfboard) or printed circuit boards (let's call both "PCB"). For most projects I use #4-40 sized screws to hold the PCB to the chassis. For larger boards, or where heavy components are mounted on the board, it may be wise to use #6-32 hardware. Or alternatively, if your project is ultra-miniaturized, try using #2-36 (my eyes don't allow that one).

If you've ever tried to get a #4 or #6 hex nut onto its machine screw, you will understand why I think one of the great product designs of all time is the little red "nut starters" that Heathkit supplied with their kits. They held a #4 nut on one end, and a #6 on the other end. If anyone knows a source for these tools, please contact me (see "Connections").

Fig. 1 shows a method for mounting PCBs to a chassis. Short #4 machine screws are used to hold the PCB, and these are held fast by threaded standoffs (also called "spacers"). These components come in both metal and insulated forms, as well as threaded and non-threaded. The reason that a short machine screw is needed is to prevent taking up too much space inside the standoff, so that the machine screw that is inside the rubber foot can be accommodated.

Whether you select metal or insulated standoffs depends on the application, and whether you want to carry the ground connection through the standoff. I personally believe that is a poor practice, and in all of my projects I supply a separate ground connection. This connection is usually made at either the signal connector ground lug, the DC power supply ground lug, or a separate ground lug attached to the chassis.

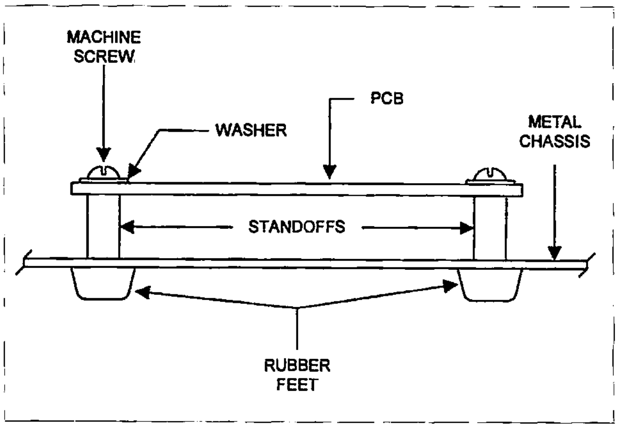


Fig. 1. Mounting a PCB with rubber feet on the chassis.

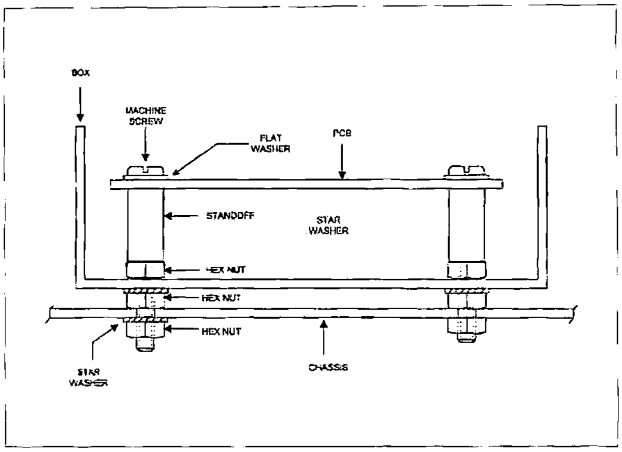


Fig. 2. Mounting a shielded box and PCB to chassis.

Fig. 2 shows a slightly different situation. In this case, the PCB is mounted inside a shielded box or enclosure, which is in turn mounted to a chassis. If you don't use a threaded standoff, then fasten the standoff together with the PCB using a separate hex nut. Pass the threaded end of the machine screw through the box, and fasten another hex nut and star washer. Finally, pass the machine screw through the chassis, using a second star washer and hex nut combination to hold the entire assembly.

Feedthrough capacitors

Several different types of connector are available for bringing RF into or out of the shielded enclosure. Low frequency and DC lines can also use certain types of connector. Indeed, I've used RCA phono jacks for both signal and DC lines (although *not* on the same project!). I've also used DIN audio connectors, XLR/XLS audio connectors and Amphenol 126-x connectors for DC and low frequency signals. However, there are times when you want to pass a DC/LF line through a chassis or shielded box in such a manner that prevents RF from getting into or out of the protected space on the wire. This is where you need a feedthrough capacitor (called "EMI filters" in some catalogs).

Fig. 3 shows two types of feedthrough capacitor. One form is mounted with a hex nut, while the other form is the soldered type. In both forms values of 500 pF, 1,000 pF and 2,000 pF are usually available. SESCOM (see below) offers some low-cost feedthrough capacitors.

Metal flange boxes

Aluminum flange boxes (**Fig. 4a**) are a staple of the electronics constructor. Some of these products are quite good, and others are not too useful (some are garbage). Flange boxes have top and bottom half-shells that fit together to make an enclosed box.

There are two things to check for when planning a housing for an RF project. First, it should have an overlapping flange as shown in **Fig. 4a**. If the top and bottom are butt-fitted with no overlap, then shun them. Those boxes have neither strength nor shielding. Second, the box should be made with a precision fit. If the top and bottom half-shells don't fit well together, or if there are gaps in the fit at some points, then the box is not much use for RF construction (or sensitive non-RF projects, for that matter).

If you obtain a good quality box with a flange, then you must decide whether or not the shielding is sufficient. The boxes typically come with four sheet metal screws, two on each side, to hold the half-shells together. For most projects in the lower end of the RF range this arrangement is sufficient. However, at higher frequencies you will want to beef up the RF seal by using additional sheet metal screws as shown in **Fig. 4b**. You will probably have to supply your own screws, as I have not seen any commercial

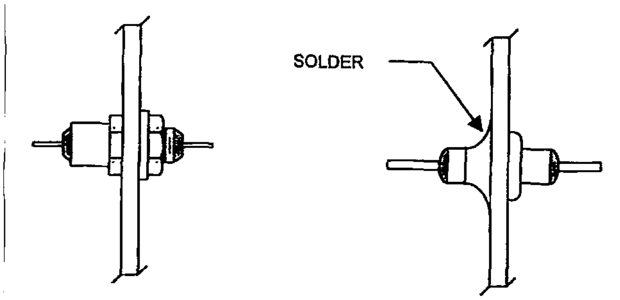


Fig. 3. Mounting feedthrough capacitors.

boxes that come with more than four screws.

If you are either very intrepid, or a bit of a fool like me, then you might want to consider making your own boxes. One of the neat things I learned to do in junior high school metal shop was operate a bench brake. This tool allows you to clamp a piece of sheet metal between two surfaces, and then using a pair of handles, rotate one surface upwards, producing a bend up to 90 degrees in the metal. By properly planning the box "in the flat" and then bending it, you can make your own box of any shape.

Other forms of metal box

A number of times in my building career I've needed specially sized or shaped boxes that were not easily available on the market (although that might change now ... see the SESCOM discussion below). If you go to the type of hobby shops that cater to model builders, you will often find a display of brass sheet metal strips, solid rods and hollow tubing. These can be formed into squares, rectangles or other shapes using ordinary tools. Bending can be done on a bench vise, or using pliers.

If you have access to a jeweler's supply store (or lapidary shop), then you also have access to a number of special tools that are also of use to amateur radio constructors. These tools are used by silversmiths, amateur and professional. A jeweler's saw, for example, is a kind of jig saw that can be used to make very intricate cuts, as well as standard straight-across cuts. If you buy one of these saws, I also recommend you buy a book on making silver jewelry in order to learn how to use the saw.

Jewelry supply stores also have tiny drills that can be used to drill fine holes in printed circuit boards or metal chassis. I've used both the Fordham Flex-Tool™ and the Dremel MotoTool™ for both jewelry and radio constructing. The Dremel (which I actually own) has a large number of accessories that can drill, burnish, grind, cut (you've probably seen the TV ad ... it'll do anything but hammer).

Another little-known but terribly useful tool used by jewelers is the parallel-jaw pliers. These pliers look like ordinary heavy-duty flat-jaw pliers, except that the planes on the inside of the jaws remain parallel as the handle is squeezed. If you try to make a bend in a piece of sheet metal with ordinary pliers, then you will find that it is skewed to one side. The parallel-jaw pliers eliminate this problem.

Plastic boxes

Plastic "utility boxes" have a lot of applications in electronic construction. I've used them for a lot of instrument and power supply projects. However, for most RF projects they are not too useful—they do not have any shielding to offer!

Plastic utility boxes are easy to work, and have some really attractive features (especially where insulation is needed on the outside, or where appearance is an issue). If you absolutely must have both shielding and a plastic box, then there are a couple of alternatives. You could spray paint the inside with conductive copper paint (not all copper-colored paint

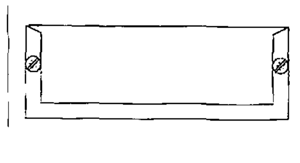


Fig. 4a. Flange box.

is conductive!). Second, you can buy thin copper foil and cement it to the inside of the box. Very thin foil can be bought from the type of hobby shops that cater to dollhouse makers. They use the foil to simulate the copper roofs that were once popular on houses. By the way, I've used such copper foil for making shielded small loop antennas.

Passing a wire through a shield

If you make a project that has internal shielded compartments it might be necessary to pass a DC power supply or signal wire from one compartment to another. If the wire carries DC, then a feedthrough capacitor could be used, but for signals a feedthrough capacitor could short the signal to ground. I sometimes use the smallest size grommets to do this job (**Fig. 5**). It works quite nicely. Drill a hole in the partition to accept the grommet's barrel diameter. There are three diameters on a grommet. The outside diameter (o.d.) is the overall diameter of the part, while the inside diameter (i.d.) is the diameter of the hole through the diameter. The barrel diameter (b.d.) is the diameter of the center portion that fits through the hole (**Fig. 6**). One of the mistakes made by some constructors (including me) is to improperly size the hole for the grommet. I match the shank end of a drill bit to the b.d. of the grommet to make the selection.

Some neat boxes from SESCOM

From time to time *73* advertiser SESCOM sends me samples of their small metal boxes for electronics projects. Most of the time, I buy some more for my own because they are so useful. If you've been disappointed with the quality of boxes sold in certain chain

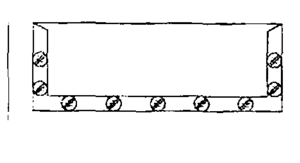


Fig. 4b. Flange box with additional screws.

outlets, or even from some major mail-order outlets, then you are going to be delightfully surprised at the SESCOM offerings.

First, let me suggest you contact SESCOM for their product brochures: 1) Constructor's Hardware, 2) Audio Construction Made Easy, 3) Audio Solutions, and 4) Lab Box-It™. Let's take a brief look at these products.

For a number of years I've used the SESCOM SB-series RF shielded boxes (see Constructor's Hardware). After SESCOM provided a sample, I ordered more than $100 worth on my own for projects in "Joe's Basement Mental Therapy Laboratory" (where I let the wind out of my head by doing electronics projects!). The SB-series boxes are tin-plated steel with covers that have RF-style "finger flanges." SESCOM also sells low-cost RF feedthrough capacitors to allow DC and low frequency lines to pass in or out of the box without spraying the internal RF all over the place. When you compare the SESCOM price for these capacitors with what you find in the major suppliers' catalogs, you are gonna be impressed!

The latest product samples SESCOM sent are their Lab Box-It™ (LAB-x) and Mini Box-It™ (MPB-x) aluminum boxes. These boxes come in "kit form" and you assemble them yourself. Each kit has two end pieces, top and bottom pieces, two side pieces and four extruded stiffeners for the corners. Tiny sheet metal screws are used to hold the assembly together by fastening the end plates to the

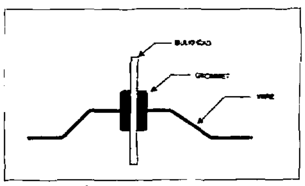


Fig. 5. Using a grommet to pass a wire through a box.

Number 52 on your Feedback card

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119
[clhough@pacbell.net]

QRP transceivers for microwave operation

This month I would like to describe how the San Diego Microwave Group has cranked up the QRP microwave construction mill and produced a variety of low power transceivers. In doing so I want to get into some of the considerations needed to make a transceiver function using low frequency drivers, such as two-meter or similar multimode rigs.

The bands that rigs were constructed for include 1296 through 10 GHz. The equipment was all home-constructed from "found" surplus or some of the excellent surplus electronic materials we obtain from Qualcomm Electronics.

We are fortunate that Qualcomm has allowed our group access to surplus material for amateur radio use only. Our group breaks down the material to prevent the original equipment from being recycled back into commercial use. Parts that are usable to the amateur radio community are made available. The main unit to be briefly discussed here is the synthesizer our group and many others have used as the basis for a transceiver converter for many of the microwave bands.

The easiest rig or microwave transceiver that can be constructed using these parts is a QRP rig for 2304 MHz. While we are able to obtain materials from Qualcomm to assist us in this construction project, other sources must also be used. The main ingredient obtained from Qualcomm is the synthesizer/local oscillator. The basic synthesizer operates at 2620 MHz and is converted to 2160 MHz for mixing with a high-frequency IF radio. A two-meter radio (IF) was selected, as this gives the filters a chance to remove the lower mix product 2016 MHz (2160 - 144 MHz).

Many parts need to be assembled to construct a complete converter. The basic components are the same for every one. They include an RF preamplifier, transmitting amplifier, mixer, filter, and RF/IF switching. The converters I will describe will be constructed to operate from 12 volts DC and be driven with a two-meter low-power HT or similar transceiver. Because the transverter is linear in operation, it can be used on any mode of transmission but is especially suited for narrowband FM, SSB, and CW. All modes of transmission are supported in an identical fashion, as you only have to change the mode on the driving HT or rig to change modes. No circuitry changes in the transceiver are required for this operation.

Normally SSB is the preferred mode of transmission for most operations. FM is reserved for stronger signal paths or those such as mobile operators who often have very distorted SSB speech because of Doppler paths arriving at varying times. In this case, narrowband FM can cut through the clutter of the Doppler and make communications readable—providing signal strength is strong.

This type of transverter is normally driven by a multimode two-meter source. The only requirement is that the driving source be of low power on transmit to prevent burnout of the transverter's mixer. If the two-meter rig can output high power levels to the mixer, a piece of "unobtainium" could be destroyed. To prevent this, my two-meter rig, an old-style two-meter transverter, was modified by removing the power output stage to prevent any possibility of high power feeding the mixer.

This is a drastic step and those with expensive, newer two-meter radios might not want to take it. The alternative is to place an attenuator in the coax to reduce the power to acceptable levels for injection to the mixer. Normally, a power level 50 mW or so, near the +10 to +15 dBm level, is perfect. It is low enough that it will not cause mixer burnout and yet still high enough to provide proper injection to the mixer. You can push this drive level with higher level mixers to something near +17 dBm as a maximum drive level.

In receive, you will have to switch out the attenuator to have maximum sensitivity on receive. If you were to leave in a 20 dB attenuator that would be required for use on a 10-watt rig, it would attenuate the receive signal by 20 dB as well. By switching out the attenuator on receive, you allow the receive section to operate with maximum sensitivity. This switching circuit can be either an automatic relay selection circuit or a simple toggle switch affair.

If you choose to use a toggle switch, be sure to throw it to transmit prior to actually transmitting, as the 20 dB protection attenuator is not in the transmit path unless the toggle switch is operated first. In manual operation with a several-watt rig for the two-meter transceiver, it can be an easy slip of the hand to get out of switching sequence and destroy the mixer with high power. It is indeed an expensive price to pay for not using mixer switching protection, since mixers for the microwave bands are not inexpensive.

The best remedy to avoid this problem is to incorporate some switching protection for the mixer. Several variations of this scheme can be used to great success. The circuit that can be used for protection from a 10-watt

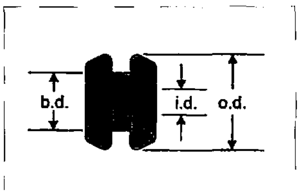


Fig. 6. Standard grommet.

extruded stiffeners. A standard #1 miniature Phillips™ screw driver will do the trick. The side and top/bottom panels are held in the stiffeners by sliding them into the slots on the stiffeners.

There is a wide variety of sizes of both forms of box, so most constructors should be able to find what they need. As an experiment, however, I decided to make a custom size box from one of the LAB-x boxes. I used a jeweler's saw to cut the extruded stiffeners to a custom length. It was a bit tricky to ensure that all four cut stiffeners were the same length, but a little work with a fine Swiss file did the trick (recommendation: cut them a millimeter or so over length and then file them down). The sides, top and bottom panels are made of aluminum, so they cut nicely with a pair of straight sheet metal shears (don't use the curved-style sheet metal shears).

One of the really neat things about the LAB-x series of SESCOM boxes is the variety of end plates that are available. The boxes come with blank end plates, so you can drill your own holes. But a number of different pre-cut end plates are also available. Included in the list of "specials" are:

A) 0.25-inch for RCA phone jacks.

B) 3/8-inch for quarter-inch phone jacks and standard bushing rotary switches and potentiometers.

C) Two 3/8-inch (see "B" above).

D) Two 5/16-inch banana jack holes.

E) SO-239 chassis mount "UHF" coaxial connector.

F) 3/8-inch "D" shaped for BNC connectors.

G) 1/2-inch "D" for isolated BNC connectors.

H) DB-9 and DB-25 computer connectors (ever tried to cut one of those with a Swiss file?).

I) Special holes for male and female XLR audio connectors.

Not all styles of special end plate are available on all boxes, but the assortment is broad enough to allow most builders to save a lot of time.

Connections

I can be reached at the address listed at the top of the column.

SESCOM: 2100 Ward Drive, Henderson NV 89015-4249; 1-800-551-2749 (orders), or (702) 565-4828.

transceiver (two-meter) can be constructed from a few extra parts. These parts are added to the mixer port to prevent direct contact between the transmitter and mixer port.

What the circuit consists of is a basic MMIC op amp driving a fixed resistive attenuator. The type of MMIC is not critical, as the frequency of operation is quite low—in the 145 MHz range. The gain of the op amp is determined by the value of the attenuator required to limit transmitter power to the required drive level. For instance, my Yaesu FT-480 two-meter multimode rig puts out 10 watts of power. Inserting a 20 dB attenuator reduces the 10 watts to 100 milliwatts (10 watts = +40 dBm, 1 watt = +30 dBm, and 100 mW = +20 dBm).

In the transmitter path, a fixed 20 dB attenuator would be switched into the transmitter path towards the mixer when transmitting. The op amp and another 20 dB attenuator are connected in the normal receive path. This combination has zero gain, so on receive its action is transparent. Should the switching fail, transmitter power will be attenuated by the receive 20 dB pad and feed the op-amp output backwards. Feeding the op amp backwards is additional protection against power getting to the mixer.

This receive attenuator can be made from two-watt carbon resistors. The transmitter's 20 dB attenuator should be capable of handling the full 10 watts. In this scenario, there is no damage to either the mixer, op amp, or attenuator.

This changeover can be automatic, derived from an RF-detect circuit on the IF coax path, or it could be nothing more that a simple manual toggle switch. In either case, with this power protection circuit the transverter's mixer is protected from certain switching errors preventing high power to the mixer, *and* replacement costs for a new mixer.

There have been many different switching circuits labeled fail-safe that would switch attenuators in the transmit path prior to power output from the IF driving transceiver. Our Microwave Group has found several two-meter rigs that even when in the low power mode will output high power for a small fraction of a second. This short burst of power is too quick to be observed on a normal metered power meter. So it's better to assume that all rigs can present a danger to a costly mixer. Protect it!

If you are a dedicated microwaver and have the microwave frequencies in your blood, you will probably do as I have and remove the high power capability of your driving IF radio. No one likes to cut into the circuitry of any new radio to modify it, especially since the cost of a multimode radio today is quite high. However, if a used multimode were to be modified, there are several approaches that can be taken to minimize the permanent modification to the radio. These are alternatives to the RF switching protection circuit.

Most of these radios have a low-power switch which will limit power to less that two watts or so. Don't depend on this switch, since being a switch it can be depressed—and you're in trouble with too much power to your transverter. The solution I took to this problem is to open up the radio and determine from the schematic or measurements what function the switch is performing. Then duplicate it in hard wiring, making the switch function permanent. Now if you accidentally operate the low-power switch, you're still permanently switched to low power and can't go to high.

The beauty of this simple modification is that with minimum effort you can return your radio to normal function in a matter of minutes by clipping out the switch wire strap.

Another possible modification is to remove DC power to the final RF stage. This trick was discovered when low power was reported as trouble on a friend's radio. In this case, the actual trouble was that the final transistor was blown open possibly through poor SWR or whatever took the device out (if the transistor has failed in the shorted mode, this trick won't work).

In retrospect, the driver was putting out less than a watt with the final transistor in this "blown" state. Another creative way to reduce maximum power output is to do what Kerry N6IZW did to a old ICOM IC-245 rig. He modified a pre-driver RF amplifier stage that was emitter-biased with a 10 ohm resistor to ground. Changing this resistor to one of about 1 kΩ permanently powered down the amplifier strip to about 100 mW.

This pre-driver stage was now just tickling the driver with minimal RF to barely turn on the driver and final with insufficient drive for full power output. This was just what the doctor ordered: a permanent condition forcing the transmitter on low power of 100 mW output all the time with minimal modification. To restore this conversion to normal, just short the 1 k resistor in the emitter circuit with a 10 Ω resistor and the transmitter is back normal. What could be better than limiting drive to the pre-driver and driver/final amplifier string? Power was adjusted to obtain just under 100 milliwatts of output power, by trimming the 1 k resistor to the proper value for the power output required.

In this manner, the modification took a few parts and some surgery but still allowed the radio to be retained in nearly intact condition. I plan to modify my IC-245 in the same manner. I also want to incorporate a power switching circuit to switch between transceiver driver circuits and normal 10-watt operation. I will investigate just what kind of switching method can be used to allow bulletproof, fail-safe switching between power levels.

I know what I said about the dangers of unreliable power switching (toggle or slide switch), but I'd like to see if something can be done reliably—possibly the addition of a plug connector or a key-actuated toggle switch on the radio. When the plug is removed or the key is inserted and turned in the switch lock, the radio is in permanently-low, 100 mW power output. Inserting the plug or turning the new switch off switches the bias circuit back to the 10 watt position. At least that or something similar to that position is what I am pondering and will tinker with.

A last word about two-meter multimode radios. I am not too hot about one feature of the ICOM IC-245 radio for portable work. The problem lies in the red LEDs in the frequency display. When used in portable operation (out in direct sunlight), the display is quite hard to read. Even in most outdoor conditions, you have to shade the display and squint to see a faint display. It's not the radio's fault but instead just the design of the frequency display and the use of the red LEDs.

This problem is quite prevalent in early two-meter multimode radios of this period. The exception to this rule is the ICOM IC-202, which has a velvety smooth VCXO-controlled dial with operation limited to (LSB) SSB only. Another possible radio is the Yaesu FT-480 multimode rig, which uses a green fluorescent display and is quite bright in direct sunlight. It's another example of older multimode radios that can be made quite valuable as drivers for microwave converters.

New radios are available, with the most inexpensive multimode model being by Yaesu, the FT-290R. This radio is still being offered by Yaesu for under $600 brand new. Ham Radio Outlet™ and other retailers have it, I am sure. The rig sports full multimode operation and an LCD display that can be observed in direct sunlight. It will output 10 watts from 12-volt installations but with the optional battery pack will put out two watts for portable stations. Sounds just like the thing to think about if you want to start with a new multimode radio. It's not overly pricey, has multimode capabilities, and has a display that can be used in daylight or direct sunlight.

Well, that's it for this month and some of the approaches we have put to use in converting our low-power two-meter radios. High power is not always the answer. Indeed, it's very interesting how low-power applications can be quite satisfying. With power levels under a couple of watts on most converters, very interesting propagation and just good old fun are always available with QRP operation.

73 for now, Chuck WB6IGP. 73

Number 54 on your Feedback card

QRP

Low Power Operation

Michael Bryce WB8VGE
955 Manchester Avenue SW
North Lawrence OH 44666

Have you ever had one of those days when everything you touched fell apart? Well, *I* sure have. In fact, the last several weeks have been filled with days just like that. Seemed everything I looked at, touched, or read about fell apart or just plain broke on me. After unloading box after box of radio equipment from storage, I decided to check each and every piece of gear out before placing it once again in service. Hindsight always being 20/20, I should have left everything in the boxes.

Out from the stack of junk came my banged and beaten Century 21. If you recall, we repaired this thing some time back. It seems the hand of death has closed upon the ol' Century 21 once more.

A brief look at the Century 21

Just in case you missed it, the Century 21 is a multiband transceiver. The Century 21 covers 80, 40, 20, 15 and 10 meters. You can install an optional crystal for more

Photo A. The audio mixer and preamplifier board inside the Century 21. This board is located on the bottom of the chassis.

segments of the 10-meter band if you wish. Oh, yes, lest I forget, the Century 21 is CW only—there's no SSB on this guy!

The Century 21 has a direct conversion receiver. It has neither IF amplifier nor IF mixers. RF signals are directly mixed with the VFO to produce audio. There's more than enough audio to drive the internal speaker to glass-breaking volume. An internal power supply runs the entire rig, which is something most direct conversion rigs can only dream of.

RF flow in the Century 21

Perhaps we should look at the RF signal flow from the antenna to the audio stages.

Signals from the antenna are first routed to the RF front end, circuit board 80359. Here, signals from the crystal oscillator are mixed RF from the antenna. The resultant signal is now routed to the audio preamp board, 80356. On this board, the direct conversion of RF signal to audio happens.

And the magic that makes this happen is called the receiver product detector. In the Century 21, the product detector is composed of four matched diodes. This arrangement is called a passive detector.

In direct conversion receivers like the Century 21, the resultant audio is amplified, filtered, and then amplified once more. All of these bring us to the problem at hand: distorted audio.

The problem in detail

After I had the rig up and running, I let it cook on 40 meters. After a half hour or so, the audio from the speaker began to sound distorted and finally it failed. By poking inside the rig, I could make the audio pop up, but it was seriously distorted. It sounded like the speaker was shorted internally.

So, a quick test or two was in order. First, the shorted speaker was quickly ruled out by using a spare speaker. The classic fingertip on the volume control seemed to produce a nice large buzz from the speaker.

Keying the rig showed 35 watts RF output on the correct frequency. However, there was no sidetone being generated. To top things off, the audio filter seemed to be inoperative as well.

All the voltages into and out of the modules were within specifications. No, the trouble had to be in either the preamplifier or the filter. No sidetone, no filters, the problem just had to be on the 80356 audio preamp board.

Getting to the board

Naturally, the preamplifier board was one that does not plug in. It's hard-wired to the rest of the Century 21's plug-in boards.

To remove the preamp board, you need to first remove all the knobs and control hardware. Then you can remove the front panel. I found an easier way.

There are several sheet metal screws holding the preamplifier board down. Also, there is one solder joint to ground that must be undone to allow the board to be lifted up. Remove these screws and the solder joint. This solder joint is located near the center of the board at the inside edge.

First, remove the knob from the selectivity control, then the knob from the volume control. Set these aside for now. There's a metal bushing on the volume control shaft. This bushing gives the panel strength and allows the panel mounted nut something to tighten down on.

To get this bushing off, remove the panel nut first. Next remove the panel nut from the selectivity control. Now, with a thin open-end wrench loosen the chassis nut. As you loosen this nut, push the already free PC board back. Keep turning the nut and pushing the board back toward the center of the rig. You'll be able to push the board back enough so the bushing falls out. Remove the board, but don't pull any of the interconnecting wires out of their sockets.

The Century 21 is no spring chicken! The circuit boards are now showing their age. To make matters worse, when the boards were stuffed, all the pins on the ICs were bent over. This makes removing a chip a big problem. Normal desoldering techniques no longer apply. What I had to do was heat up the joint and with a sharp knife point, gently pry up the IC pins one at a time. Of course, no matter how careful I was, I managed to lift up a trace or two from the PC board.

I removed both ICs on the printed circuit board. I was so sure they had to be the problem that I didn't even take voltage measurements on the IC pins—that was a big mistake!

After a few dozen Hail Marys, it was back inside the rig once more. This time, I took my VOM with me.

All the voltages at the ICs were exactly where they were supposed to be. It was clear the problem was not located on the audio preamplifier board. As Mr. Sherlock Ohms was heard to say, "After you remove the impossible, whatever is left, however improbable, must be the truth."

What was left after removing the impossible was the audio power amplifier itself. This time, voltage checks were taken and they revealed several major problems. The audio power amplifier is based on a LM380 audio amplifier, located on the audio power amplifier board 80357. All indications pointed to a bad LM380. A new part was installed and guess what? The problem remained—as well as the weird voltage readings on the IC itself.

A closer look at the audio power amplifier showed the IC had pins 3, 4, 5, 6, 7, 10, 11, and 12 all at ground. Voltage readings showed several of these pins were, in fact, riding above ground!

The problem was finally found when a second LM380 was installed. And the problem turned out to be the heat sink holding the LM380. It appeared the heat sink was riveted to the printed circuit board. The rivets did double duty—they held the heat sink to the printed circuit board and they supplied the required ground. You see there are three ground pins on the LM380 on each side of the chip. These six leads are soldered to the heat sink. With no ground to the metal heat sink, the six

The Digital Port

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703
[jheller@sierra.net]

Worldwide contacts

I've used a lot of space recently dragging you through the software hassles of packet, but ignoring some of the real fun you can have with this mode once you get everything in place. This month I will concentrate more on the fun side.

When you choose ham radio as a hobby, you expect to make contact with other people using radios. Hams have been doing just that since the early part of the century. There was, of course, a time before voice modulation when Morse code was the mainstay and was done without the aid of vacuum tubes. Imagine being the envy of the neighborhood with your home-brew spark gap, and living in such a grand era with *no possibility of TVI*.

Hams are always on the cutting edge

The fascination with ethereal communications has attracted the serious, inventive adventurer to the ham bands for decades and digital modes now add new dimensions. Just the other day, I received a message via the regular packet network from a ham in Austria, Walter OE4TEA. He has a nice little file he inserts in his messages that gives his addresses for packet, the Internet and amateur packet via satellite.

And that is just a sampling of the many methods of ham communication we have available. Most of us focus on one or two modes and miss out on a lot of action such as amateur TV, fax, satellites, EME, and propagation phenomena such as meteor scatter or aurora. Plus, most of us ignore the extreme short wavelength bands available to us.

There is another modern day development that many hams take advantage of. We were just visited by some friends from the neighboring state of Idaho. It is only about 500 miles to his ham antenna from here but we seldom make contact on 80 or 40 meters because of the high noise level at his end.

Communication is about to be revived. While he was visiting, Graydon WB7PWS asked if I had an Internet address. Since he does not have a packet station, we will soon exchange regular E-mail via the landline—one more modern development that keeps us in touch.

I get E-mail

Since I have my Internet address listed in this column, I receive a considerable number of requests for information that I don't thoroughly cover in the printed copy. I like it when I know someone is reading. Not too long ago, I got an E-mail request from a student in Italy inquiring about budget packet projects.

It is not unusual to receive requests for Internet addresses related to ham software, when I neglect to include the address on an intriguing item I have found and described. Sometimes it doesn't occur to me how valuable that information is to a reader. With the easy availability of the Internet those problems are easily solved—at affordable rates.

Occasionally I receive helpful guidance when I let it be known that something in my trusty computer is not functioning the way it should and I am at a loss for a reason. I appreciate those messages, believe me. I am not an engineer, and even if I were, the explosion of technology in this field would be beyond the grasp of the best to keep on top of everything.

What I am saying is not meant to belittle my abilities, but to reinforce the premise that ham radio is a group of ordinary people like you and me who reach out to help one another. I learn continuously as I write this column. My primary purpose is to put ideas out to you that encourage and help you solve your problems.

Encouragement is one of the keys to successful ham radio

If some helpful Elmer hadn't reached out, most of us would never have persisted to get our first ham ticket. So, in a way, this column is a project in creating enthusiasm so you will keep after this digital adventure until you whip it. If it tells anything about me, my dog is named Elmer.

An informative, well-formatted packet message came from Geoff VK5MG relating his experiences with packet radio from Down Under. He told how he managed to get his BayCom™ modem working with Winpack™. I sent him a reply and explained my dilemma with getting a Windows™ program to talk to my BayPac™ and he sent me info on what he had specifically used for the project.

Coincidentally, I had been working with the same software and it looked like I was heading in the correct direction. For the rest of those curious about this software, I will give you a rundown on how you can get the programs and, most importantly, the instruction sheet.

The concept is based on utilizing the popular BPQ node software authored by Roger G8BPQ. With this in place you can address your internal node easily with any terminal software including your favorite Windows-based program. The secret is to use a program, NODE2BAY, to interface the node to the BayCom modem. Actually there are two programs required to accomplish this. The other is a driver, BAYDRV.VXD.

These files are available on the Internet and I have not noticed them elsewhere. Winpack has become popular and can be found on many on-line services as well as the Internet. I downloaded my copy of Winpack from the TAPR Web site [www.tapr.org].

The programs BPQ, NODE2BAY and BAYDRV that I referred to above are available from [http://www.peaksys.demon.co.uk] and they are well identified. On the same site, Paul GW7LHI has an excellent set of instructions for setting all this up. Paul's paper is about eleven pages but is in a very clear, can't-miss (nearly), step-by-step format.

I only say nearly because I found an error in reference to a batch file you must write to get this going. Actually it is merely a reference in the autoexec.bat line that you must enter that refers to the address for the batch file. So if you do this, pay attention and point the line in the autoexec.bat toward the correct subdirectory where you place the batch file that puts the show on the road during the boot process.

This foray into the world of tiny software-controlled modems has been a real eye-opener for me. The work on this area of packet radio is being primarily conducted in Europe and it is possible to build your own interface, either from a kit or piece by piece from your own parts supply. Instructions are available from some of the software publishers. My copy of

---

leads were, in fact, just sitting there floating. How the amplifier made any noise is beyond me.

The fix was simple. The rivets were removed and short pieces of hookup wire were soldered in place. At power-up, signals came pounding through the speaker—the Century 21 lives once more!

All told, the repair on the Century 21 took over a week of my time. Had I looked first and not jumped into the project without thinking, perhaps the down time would have been different.

QRP station goodies

Did you find yourself calling and calling CQ FD over and over again? That's a pooper in anyone's book. Most of us don't own a memory keyer, but the people at Jackson Harbor Press may change all of that. You see, they have a slick memory keyer that works with the keyer you may already have. It's called the Island Memory. For more information, see the review in *73* (May 1997), or send them an E-mail at [jacksonharbor @worldnet.att .net]. 73

PROGRAMS FOR THE BAYPAC AND BAYCOM MODEMS				
Program	**Success**	**Difficulties**	**Support**	**Available At**
BayCom 1.4	Excellent – works every time	DOS only – Windows must be shut down	Freeware – support possible from newsgroups	www.tigertronics.com or comes with modem
Wintnc	Very good – runs/Win95	Some nodes do not read requests	Shareware – author may not respond	www.tigertronics.com
Winpack w/BPQ NODE2BAY & BAYDRV	Good if using right setup (see text)	Complex setup did not perform with my laptop	Shareware All pgms –check at dl area at right	[all] www.peaksys.demon.co.uk [Winpack] most ham boards
HamComm 3	Good	Software works but my laptop gave problem	Try newsgroups	www.tigertronics.com
AgwBay AgwTerminal	Not tried	N/A	Freeware – contact dl site	www.forthnet.gr/sv2agv

***Table 1.** These are just a few of the available programs for the BayPac BP-2M and BayCom modems. The only definitive commercial package is the BayCom 1.6. Haven't tried it. The authors of most of the programs have only run them on a few computers. Sometimes they work for one person and not another. Everything is written by hams who have real jobs to keep the wolf away—so you work with what you find that works for you.*

the documentation for the HamComm shareware program gives a schematic and parts list.

The challenge comes in writing the software to do the job. There is a great effort being expended in Europe to write such software—and it seems to be equal to the work on this side of the waters that goes into the design and refining of multimode hardware and sophisticated software for all the other digital modes.

Some of the problems I have encountered are related to my own hardware and my local packet BBS. I have not found explanations for some of the problems, but there are some combinations that work. I have been focusing on a portable digital station based on my IBM laptop. Some of the bells and whistles of Windows 95™ tend to stifle progress.

I'm using the newer laptop because I have other uses that require Windows-based programs. However, I have come across warnings that some of the earlier DOS-based laptops also offer resistance to packet operation. This means to me that we still have an experimental hobby situation.

Some *new* news

Just as I was wrapping up the thoughts for the month, I took a look at my E-mail and found a posting from George SV2AGW on one of the TAPR newsgroups. He claims to have developed a driver for the BayCom that allows any Windows 95 terminal software to function just as if using a regular TNC.

George conveniently left a clickable [http://www.forthnet.gr/sv2agv] embedded in the message. I couldn't resist taking a look and found some good information along with several programs. I downloaded the driver and his terminal program. There won't be time to install and test it before I send this off, but I will take it with me when I go out of town next week. In a true gesture of ham goodwill, George is offering his programs as freeware! Now, *that* is an incentive.

I mentioned so many programs this month and earlier for the BayPac BP-2M that I put them in chart form (**Table 1**) so you can have ready reference. There are more out there. Just check the TigerTronics™ Web page. I just listed the ones I have tried or intend to try.

If I can put this month's column into proper perspective, that's what I like about ham radio. You get to work on it until it works—then, when it does and you know you did it yourself, you get your well-deserved thrills. A digital connection to a station on another continent or a node across town always brings that little tingle about sophisticated equipment that works because you made it do it.

Speaking of thrills, I now have a laptop that, with a few keyboard calisthenics, I can use to make a packet connection wherever I travel. For me, that provides a little excitement every time I see it work. Not world-shaking by today's standards, but something I didn't have a year ago. I still haven't mastered all the bells and whistles available from my BayPac BP-2M, but that gives me something more to look forward to.

Ham radio, by its very nature, gives each of us something to look forward to, that we can accomplish on our own—or if not, with the help of a ham friend. That's what it's all about.

If you have questions or comments about this column, E-mail me at the address in the column heading and/or CompuServe [72130.1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line [KB7NO @ N7NPB.#NONEV.NV.USA.NOAM]. For now, 73, Jack KB7NO.

Number 57 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
[dmiller14@juno.com]

A bright spot in your day

Here's another workbench pin-up that you might want to keep somewhere handy, a simple LED limiting resistor chart. **Table 1** shows the chart, which probably needs little further explanation. Most light-emitting diodes (LEDs) require a properly chosen current-limiting resistor to keep them from self-destructing, which can occur almost immediately if the resistor is inadvertently omitted. The values in **Table 1**, however, can act as a quick reference to the proper size of resistor for supply voltages from three volts to 12 volts, using standard-resistance values and keeping the LED forward current at about 10 to 12 milliamperes (which is safe in the majority of devices). Some LEDs can handle more forward current (20 to 25 mA), in which case the value shown can be cut in half. Others may perform better with less continuous current (5 or 6 mA), in which case the resistor value shown can be doubled. On average, however, most currently made LEDs seem to work nicely with the exact values depicted in the chart at the various supply voltage levels shown.

Table 2 shows the results of a spot check of several LEDs from my own collection, with exactly 12 VDC applied across the 1 k resistor/LED combination. From my brief experiments, the red LEDs seem to have the greatest variation in forward current through, and voltage drop across, the device from one to another, in a random pick ... just an observation. *—de NZ9E.*

12 volts	1 kΩ
9 volts	600 Ω
8 volts	470 Ω
6 volts	330 Ω
5 volts	220 Ω
3 volts	68 Ω

Table 1. Approximate LED limiting resistor values for 10 to 12 mA forward current.

LED Color	Forward Current	Voltage Drop Across LED
Yellow	9.7 mA	1.98 volts
Green	9.57 mA	2.09 volts
Red	9.30 mA	2.36 volts
Amber	9.72 mA	1.93 volts
Blue	8.77 mA	2.91 volts

Table 2. Results of spot check of several LEDs, with exactly 12 volts DC applied across the 1 k resistor/LED combination. The limiting resistor was kept constant at 1 k ohms.

Joys of the J-pole

From Marcel Chapleau VE2GMZ: "A few months ago, I decided to build my own J-pole antenna for two meters and 70 cm, instead of buying a considerably more costly factory-made unit. In going through my old ham files, I ran across a design that looked about right for my needs. The original was written up by John Post KE7AX and I copied his design for my first attempt.

"The antenna described by KE7AX worked out well, but I did notice two things that I felt could be improved upon. On a J-pole antenna, the coax cable is attached to the lower portion of each element (about two and one-quarter inches up from the horizontal connecting piece) while watching the SWR presented to the transmission line. At best, I could only achieve about 1.3:1 on two meters and 1.6:1 on 70 cm. Not bad, but there was room for improvement.

"Squeezing the 19-inch vertical radiating element closer to the 60-3/4 inch element (at the top of the 19-inch pipe) showed a drop in SWR to very close to unity. Based on this finding, I made up an 'L'-shaped angle bracket two inches long by one inch wide and with a one-inch drop-leg, and configured a one-and-one-half-inch slot across the top two-inch length. This allowed me to attach the 'L' section to the flat top of the 19-inch radiator's cap-piece with a single machine screw, and provided me with a 'Fine SWR Adjustment.' Now I can simply slide the 'L' piece back and forth on the 19-inch element until the SWR is as close to 1:1 as possible.

"With just that addition, I installed the dual-band J-pole at my home QTH and used it quite often for several months. I was able to reliably access a repeater 50 miles away, as well as the Russian *Mir* space station on a number of occasions. I felt, however, that the angle of radiation might be too high for good space communications (*Mir* was mainly only usable between 20 degrees to 65 degrees), so I decided to try something else. I constructed two sets of four-spoked radials, one for two meters, and one for 70 cm. The 70 cm radials (each six and one-half inches long) were then positioned six and one-half inches down from the bottom of the 'J' crossover piece, and the two-meter radials (each 20 inches long), another 13-1/2 inches farther down (a total of 20 inches from the 'J' crossover). The details of the entire antenna are shown in **Fig. 1**. My reliable repeater 'reach' now increased to 95 miles

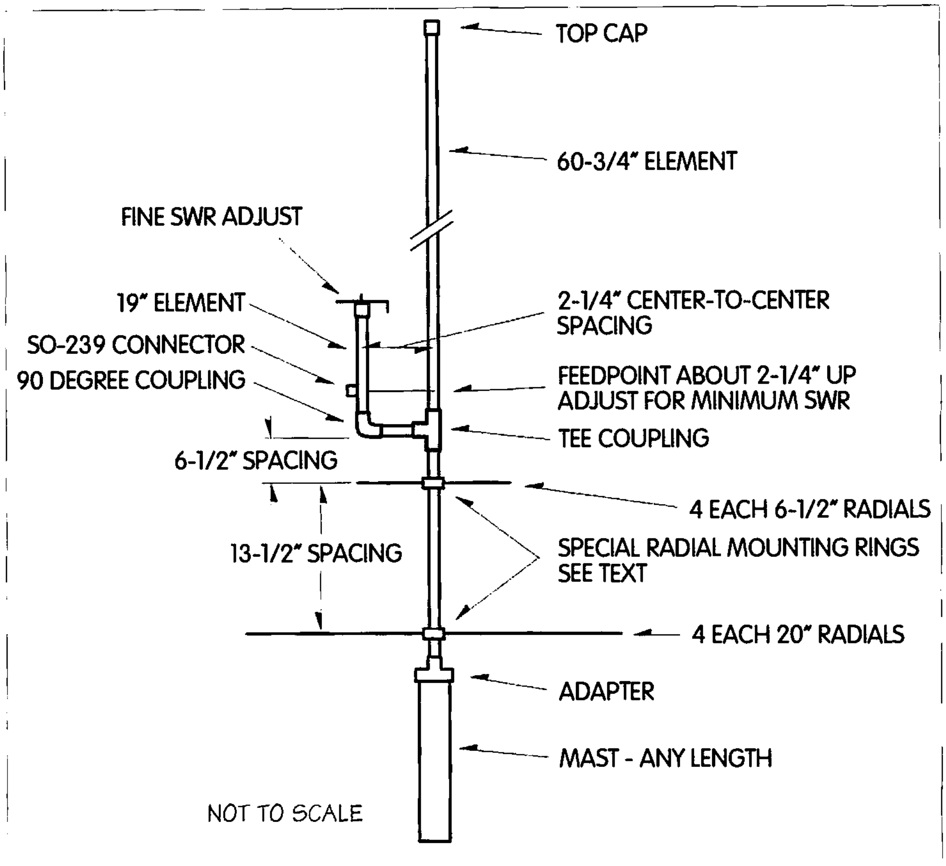


Fig. 1. VE2GMZ's "dual-band" J-pole antenna for two meters and 70 cm.

away, and I'm able to talk with a friend 45 miles down-range on simplex, just using the J-pole with its added radial 'skirts.' Communications with *Mir* were not as gratifying, however, and I suspect that perhaps the angle of radiation may now be too low.

"Needless to say, for terrestrial coverage, I've been very pleased with the results for my meager investment, and I thought my experiences may have appeal to others in the ham community."

Photo A. VE2GMZ's radial mounting ring.

Moderator's note: Marcel's dual-band J-pole dimensions are shown in ***Fig. 1****, and the radial mounting ring that he made up is pictured in* ***Photo A****. Normally, a J-pole doesn't need a ground plane or radials to perform correctly. I suspect that Marcel's added radial system (for both two meters and 70 cm) tends to "decouple" the coaxial transmission line from the antenna, so that any common-mode currents that might exist on the transmission line are suppressed, and the shield of the transmission line is no longer a part of the active "radiating" portion of the antenna. This isn't uncommon at VHF and UHF frequencies, proving that "apparent" theory and "real-life" practice are often somewhat at odds. Never argue with success!*

Marcel has kindly offered to make up copies of the special radial mounting ring that he devised for his antenna for "Ham To Ham" readers. The sample radial mounting ring that he sent me is nicely machined from 3/4-inch aluminum stock and has four holes around its perimeter to accept copper welding rod "radials." The radials are then locked into place with Allen-head setscrews at all four points. A half-inch hole passes through the center of the ring for fitting onto the half-inch (o.d.) copper pipe used in constructing the antenna, and it too is locked into place with an Allen-head setscrew. Marcel is offering a retrofit radial kit consisting of two mounting rings and two sets of radial wires, for those who might not be able to do the machining themselves, for $20 (US funds) including shipping. Write to VE2GMZ at the address at the end of the column for further information or to order the kit just described.

A switch for a switch

From Craig Stimson VA3DCS: A suggestion for an easy way to build a packet/voice TNC/mike switch: "Do you have a 25-pin computer A-B data transfer switch just gathering dust on the shelf? Looking for an inexpensive way to switch between my packet TNC and my microphone, I decided to give the spare data switch that I had a new purpose in life! Something of a role-switch for a switch! I fabricated three special cables: one DB-25 to an eight-pin mike connector that would plug into my transceiver's mike input jack; one DB-25 to the audio connector used on my TNC; and one DB-25 to the correct-gender eight-pin connector into which my transceiver's microphone would mate. Connecting everything together as shown in **Fig. 2** gave me the mike-to-TNC A-B switch that I needed, for just a fraction of the cost of a commercially-made unit. Just be sure to be consistent in your wiring so that all pin-to-pin interconnections are correct for your particular setup, and that shielded pre-made 'DB' connector cables are used for the external adapters."

Moderator's note: That's a clever "alternate" use for an A-B data switch, Craig. Even if you don't happen to have one on the shelf, they can be found quite reasonably at every ham and computer fest. Also, check out the catalogs of some of 73's advertisers; you can sometimes find the DB-25 A-B switches for about $5 and pre-made dual-ended DB-25 cables for $2 or $3. In addition to using only shielded interconnecting cables, it's also a good idea to ground all unused conductors at both ends; this will help in fending off RFI induction into the low-level microphone circuit.

Battery BASICs

From Joseph Gabus AB5RE: Here's a handy BASIC program for readers. "Back in the February 1997 issue of *73 Amateur Radio Today*, J. Frank Brumbaugh W4LJD wrote a nice article titled 'The Gel Cell Storage Battery—A great little power supply,' in which he makes the case for why it may make better sense at times to use lead-acid-based gel cells to power portable amateur gear than other competing battery technologies. To most effectively use the information in Frank's article, however, it's necessary to compute the expected operating time based

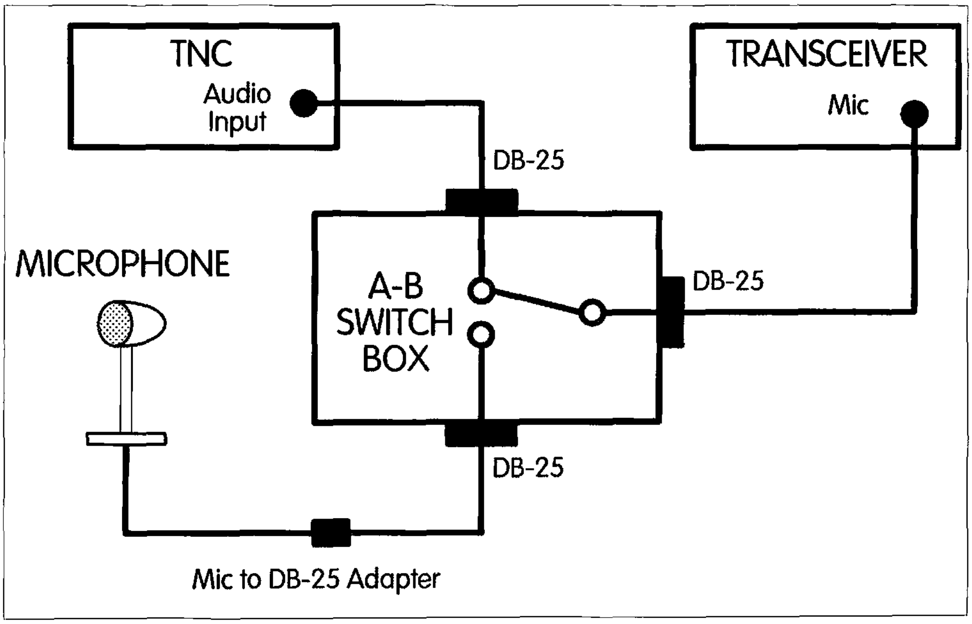


Fig. 2. VA3DCS's suggestion for using a computer A-B data switch.

upon the expected average transmit/receive duty cycle vs. the battery's ampere-hour capacity for each different battery type (i.e., amp-hour capacity) under consideration. To make the job easier and less prone to computational error, I've come up with a simple BASIC program that can be used to complete the task. Since it's written in BASIC, it's easy to modify for those familiar with that programming language, and it will run under on any computer that can utilize a BASIC interpreter; if you're using a modern Windows™ computer, you can use the QBASIC program in DOS. (See Sidebar.)

"I've called the program GELCELL.BAS. After inputting the data and calculating the results, the program gives you the opportunity to print a hard copy of the results as well as to compute another set of variables for a different battery—simply answer 'y' or 'n' to these questions. There is also a reminder printout at the top of the screen showing the results for the last computation. Line 115 gives the user the option of adding any other constant-current accessories into the calculations. It can be removed if none are ever used, or simply push <ENTER> to default to zero.

"By using GELCELL.BAS, I found that my MFJ-40 CW transceiver (which draws 1 A during transmit and .05 A during receive) could potentially operate for 80 hours, before recharging of the battery would be needed during an emergency, using just a 10-ampere-hour gel cell battery. Adding the constant current of a Radio Shack™ DSP-40 signal processor, however, raised the current demand enough to require approximately a 90-ampere-hour battery for roughly the same operating time. In that case, better bring along a husky assistant to help carry the battery!"

*Moderator's notes: I asked **Frank Brumbaugh W4LJD** to comment on Joe's implementation of the information outlined contained in his article. Frank wrote back:*

"When calculating transmitter current drain, the duty cycle (the amount of time that the transmitter is actually drawing full current during the transmit mode) must also be taken into account, as well as the ratio of receive (or tuning around time) vs. actual on-air QSO time. A 50% duty cycle is generally assumed for both CW and SSB to be on the safe side. Other modes, such as RTTY, FM, or AM, must be figured as 100% duty cycle while transmitting. Let's further assume that a normal routine might be tuning or listening for 50 minutes (5/6) out of an hour's time, while transmitting may only occupy 10 minutes (1/6) of that same hour. With the 50% duty cycle of CW or SSB, the following formula can be applied:

Current during receive = .050 A (50 mA)

Current during transmit = 1.0 A (1,000 mA)

Battery's rated capacity = 10 Ah (Ampere hours)

(5/6) of .050 + (1/6)/2 = Amperes for one hour

.042 + .083 = .1253 Amperes (125.3 milliamperes) for one hour

Battery Ah divided by Amperes-per-hour = maximum operating time

10 over .1253 = 79.8 maximum estimated hours of operating time

"The above assumes that the qualifications mentioned previously are completely accurate, of course. Any estimate of actual duty cycle is simply that ... an estimate. Additionally, you would not want to run your battery right down to fully discharged, at least not intentionally.

"Lacking a computer, you can use a hand-held calculator and get the same results by using the formula shown above.

"By the way, anyone who might be interested in pursuing the question of the care and feeding of gel cells more thoroughly can contact Power-Sonic Corporation at P.O. Box 5242, 3106 Spring Street, Redwood City CA 94063 [tel. (415) 364-5001, FAX (415) 366-3662] and ask for a copy of their free technical manual covering their line of gel cell batteries. This is a very well written treatise covering all aspects of gel cell technology. Power-Sonic is a friendly company and they courteously provided me with a great deal of assistance while I was doing research for my *73* article."

Additional note: Joe modified his program slightly to reflect the factors Frank mentioned, i.e., 1/6 RX vs. 5/6 TX duty cycle. If you assume your TX to RX duty cycle to be very much different from these figures, then you'll want to change Line 100 in the program as mentioned in the REM in Line 95.

Addition

In addition to being the least expensive of the various battery technologies to manufacture, the SLA (sealed lead-acid) gel cell packs, written about by Joe Gabus and Frank Brumbaugh, are also the easiest for determining how much relative charge is left in them. The reason for this is that the terminal voltage of lead-acid cells drops at a linear and predictable rate, from fully charged to fully discharged, allowing us to simply measure the voltage across the battery to come up with a reasonably accurate estimate of the amount of usable energy left in the battery. When fully charged, a 12-volt SLA battery pack will read an open terminal voltage of 13.08 V (2.18 V per cell). At 50% charge, the 12-volt pack will read 12.54 V (2.09 V per cell), and at 10% charge, a 12-volt pack reads 11.88 V (1.98 V per cell). When charging, the terminal voltage of a 12-volt SLA pack will rise to between 13.8 and 14.4 volts, depending upon the actual output voltage of the charger. (SLA battery packs are best charged with a constant voltage as opposed to a constant current as is the case

```
10 CLS

20 PRINT : PRINT "NAME OF RADIO: "; N$; " LAST COMPUTATION"; X; "HOURS WITH A"; Ah; "AMPERE BATTERY."

30 PRINT : PRINT : PRINT SPC(25); "GELL CELL COMPUTATION PROGRAM ": PRINT SPC(5); " TO DETER-MINE OPERATING TIME WITH YOUR RIG, BEFORE RECHARGE IS REQUIRED."

40 PRINT SPC(23); "VER. 1.1 By: Joseph T. Gabus, AB5RE": PRINT

50 PRINT "TEST DATA: 12 Ah BATTERY,  1.5 AMP TX,  0.2 AMP RX  =  40 HOURS OPERATING TIME."

60 PRINT: INPUT "NAME OF RADIO ", N$

70 PRINT : INPUT "AMPERE HOUR GELL CELL BATTERY CAPACITY ", Ah

80 AHR = .05 * Ah: PRINT "CHARGE / DISCHARGE RATE FOR 20 HOURS = "; AHR; " AMPERES/HOUR"

90 PRINT : INPUT "TRANSMITTING AMPERES = ", TA: INPUT "RECEIVE AMPERES = ", RA

95 REM Note that the formula below assumes 50 minutes of RX time and 10 minutes of TX time. Contest (or other high ratio transmit operations) will require a change to be made to the formula.

100 AC = (5/6*RA)+(1/6*TA)/2 : PRINT "AVERAGE CURRENT DRAIN PER HOUR = "; AC

105 REM The next 3 lines allow for the use of the accessory(s) of your choice.

110 REM PRINT "ACCESSORY: DSP-40 CURRENT DRAIN = 1.0 AMPERES

115 INPUT "ACCESSORY CURRENT DEMAND IN AMPERES (Default is zero) = ", ACD

120 AC=AC+ACD: PRINT AC; " = AMPERES WITH ACCESSORY."

130 X = Ah/AC

140 PRINT : PRINT SPC(20); "APPROXIMATE OPERATING TIME = "; X; " HOURS."

150 PRINT "HARDCOPY PRINT OUT? <Y/N> "; : INPUT C$

160 IF C$="Y" OR C$="y" THEN LPRINT "RADIO "; B$, C; "AMPERE BATTERY", INT(Y-1);  " HOURS."

170 PRINT "QUIT PROGRAM NOW <Y/N> "; : INPUT A$

180 IF A$="Y" OR A$="y" THEN GOTO 210

190 GOTO 10

200 REM DATA SOURCE: "The Gel Cell Storage Battery" - Frank Brumbaugh, W4LJD, 73 Magazine, Pages 41-42, February, 1997.

210 END

220 REM Note that your experimental results may differ somewhat. If your radio quits at 72 hours, for instance, and the computed answer was 80 hours of projected operating time, then change Line 130 to X=(Ah/AC)-8. This adds a bias to the program to compensate for the actual parameters of your particular Gel Cell battery. Batteries will change Ah capacity with age, temperature and percentage of charge (time since last recharge).
```

AB5RE's GELCELL.BAS program (see text).

with NiCd and NIMH cells.) As mentioned. this linear terminal voltage drop-off in lead-acid cells (again. unlike NiCd and NIMH cells) makes it quite practical to use an expanded-scale DC voltmeter to measure the relative percentage of charge left in the pack. This

Number 61 on your Feedback card

On the Go

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

Mobile HF Operations

Last month I wrote about some ideas for installing an HF rig for mobile use. While using such a station is not much different than operating a UHF or VHF rig, there are a few key differences. First, a repeat of a cautionary word from last month. Never let your radio operations interfere with the safe operation of your vehicle. I know that seems like basic common sense. It's similar to telling my son Paul N8YDQ to be careful when he goes out. He has no intention of intentionally allowing himself to be injured, but it makes me feel better to say it.

There are two big differences between working a repeater and working the "low bands." First: The frequencies you work are not as clearly defined as with VHF/UHF. Second: There is a desire to log contacts, which normally doesn't exist with contacts made on the local repeater. Each of these, if properly managed, will prove to be little distraction. The trick is to plan ahead.

After playing with various approaches, I made a few decisions that I felt made the operation manageable. First, I decided to pick one band and stick with it for most occasions. I had initially tried working multiple bands, but later decided that approach was not the best. First, this required a multiband antenna which had resonators for five different bands. While to me this looked good, others referred to my vehicle with its 2-meter/440 antenna, cellular antennas and HF array as looking somewhat like "a porcupine in heat."

There were essentially two reasons for my decision to concentrate on one band. First, the multiband needed to be folded over before I could pull into the garage. As I lived in northern Ohio at the time, this meant getting out of the car in rain, snow, etc. The Akron/Cleveland area only gets about 30 days of clear skies each year, so this was more than an academic issue. A single-band antenna with a flexible tip could be pulled over from inside the car by attaching fishing line to the top of the antenna and fastening the other end just above the driver's window. Depending on the car, either a gutter clamp can be used, or if there is no gutter, a magnet can hold the other end of the line. You can open the window, pull on the fishing line, and bend the antenna over on the way into the garage. Even if you forget occasionally, if you have a flexible tip antenna and a spring at the base of the antenna, usually you can expect no damage to the antenna or the garage door.

Second, after trying various bands at various times, I decided that my best overall band to use would be 20 meters. You can still keep several other antennas (and the appropriate wrenches) in the trunk, but personally I prefer to stay on that band. 20 gives you a reasonably good chance at working someone at any time during the day or evening. Besides, it also gives you a good chance at working some interesting DX—if the sunspots cooperate.

Naturally, when working interesting stations you will want to record the information and follow up with a QSL card. Besides, even today a QSL card is still considered the final courtesy of a contact. When working from the ham shack at home, it is easy to log each contact. In a car, whether in traffic or at 70 MPH on the interstate, it may be somewhat trickier. I've tried clipboards on the passenger seat, but found that if I don't look at what I'm writing while I'm writing it, my chance of being able to read it later is marginal at best. I began using a small tape recorder which worked pretty well. The small digital recorders which can attach to the visor make life much easier. If the rig has a digital frequency meter and your car has a visible clock, it is a simple matter to press the record button and dictate the frequency, local time, call sign of the station worked and signal reports without taking your eyes off the road for more than a moment. If you're far from home, you may also want to record your location, particularly if your QSO is with a county hunter.

Many times, rather than trying to find a station that is calling CQ, I'll find a clear frequency merely by feel. I'll glance down at the frequency read out to make sure that I haven't drifted outside the appropriate band, and do the three calls to determine if the frequency is in use. Then I'll call CQ. Maybe it's luck, or maybe it's just coincidence, but I've found that the response I get when calling as a mobile seems to be significantly better than when I call from a fixed location. I guess it's just novel enough to catch other hams' attention. In any case, it's fun to get a better response when using a lower-powered rig and a significantly smaller antenna.

When you have a passenger, sometimes he or she may enjoy hearing you operate, especially if you're talking to someone in an interesting location. This may not only amuse them, but often your passenger will be willing to assist by doing your logging for you. If you're speaking with a US station or one in a country with whom we have a third party traffic agreement, let your guest at least say hello. Who knows? This may be the first step in getting someone interested in becoming a ham.

There are a few things that will help make your HF mobile operations more convenient. Since

---

means that an easy-to-build meter, like the one described by Frank Brumbaugh in last month's "Ham To Ham column," can be really helpful in preventing excessive drain-down (see *73*, October 1997).

That's all for this month—be sure to be with us again next month for more worthwhile tips, ideas and suggestions ... ham to ham!

Murphy's Corollary: The test lead on any multimeter will break just before you've finally zeroed-in on the fault that you're troubleshooting. Having to stop and fix the test lead is Murphy's contribution to building your patience and character!

As always, many thanks to those readers who've contributed their time and ideas to this month's column, including:

Marcel Chapleau VE2GMZ
4, De Langloiserie
Blainville QC J7C 4L6
Canada
[ve2gmz@sympatico.ca]

Craig Stimson VA3DCS
302-2311 Ontario Street
Oakville ON L6L 1A5
Canada

Joseph T. Gabus AB5RE
Route 2, Box 91-A
Bowie TX 76230

J. Frank Brumbaugh W4LJD
P.O. Box 30
c/o Defendini
Salinas PR 00751

If you're missing any past columns, you can probably find them at *73*'s "Ham To Ham" column home page (with special thanks to Mark Bohnhoff WB9UOM), on the World Wide Web, at: [http://www.rrsta.com/hth].

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or 73 for any equipment damage or malfunction resulting from information supplied in this column.

Please send any ideas you would like to see included here to the moderator at the address shown at top. We will make every attempt to respond to all legitimate ideas in a timely manner, but please send any specific questions, on any particular tip, to the originator of the idea, not to this column's moderator nor to *73*.

Number 62 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

One nice thing about this column is that it often reminds me of a multi-level marketing scheme. One item in the column can generate many responses, which leads to more items, and so on. This month, let's see what some of you have responded with.

The material on Gary Johnson's XPWare RTTY software resulted in a note from Larry Winslow WØNFU. He writes:

"I just read your column in the September 1997 issue of *73*. You might not be aware of it, but there is a companion logging program for XPWare called XPLog. The DOS version is currently available on Gary's BBS (where all of Gary's software can also be obtained) and the Windows™ version is about to be released, hopefully by the middle of September."

Gary's software collects logging data and only has the ability to show the previous contact when connecting to a station. He didn't provide any capability to look at all of the data he's been collecting. When I first got a copy of XPCOM (about a year before its first release), I volunteered to write the program to do what his programs don't. After the first release of XPLog, I received quite a few suggestions for expansion of the functionality. Now it is quite extensive including antenna headings, browsing by call/date/name/QTH printing labels and/or log reports, etc. Just as Gary's software is shareware, so is XPLog and the current fee is $20.

Larry, thanks for the reminder. I had seen an earlier version of XPLog, and am glad to hear you are coming out with a new version for Windows. I will look for it on the XPWare site, at: [http://www.goodnet.com/~gjohnson/], as well as try to add it to the RTTY Loop Software Collection.

Another note comes from David M Sundheimer WØNBZ, of Burnsville, Minnesota. Dave writes:

"Twenty years ago I loved to copy press transmissions on my Model 28. I've got some solid state gear now, but I can't find any press frequencies. Can you help? Just point me in the right direction, if you would."

Well, Dave, several times over the last few years I have mentioned the excellent series of books containing press frequencies published by Klingenfuss Publications. Along with a catalog and price list of their books, you will find some sample "hot" frequencies at their Web site, at: [http://ourworld.compuserve.com/homepages/Klingenfuss/]. Check it out. When I did as I was writing this column, there were more than half a dozen stations and frequencies to check out. Of course, you can always get the book, but that's another story!

Another topic which has seen quite a bit of play of late has been the demise of AEA. With many hams owning AEA TUs and TNCs, the potential orphaning of their equipment has resulted in an increased viewing of late night television. Well, now I can direct you to the Web site: [http://www.timewave.com/amprods.html], where the acquisition of AEA by Timewave is described. Timewave has completed the purchase of all the AEA (Advanced Electronic Applications, Inc.) products except the antennas and antenna analyzers. Timewave will offer new product sales as well as warranty service, repair, and firmware upgrades for existing AEA products. I will be in touch with Timewave, and see if they will keep us posted on progress. Otherwise, I would keep an eye on the Web site, if I were you—especially if upgrade or repair information is important.

On a related note, Tempo Research Corp., of Vista, CA has acquired the AEA antenna analyzer and antenna product lines. Contact them directly for information on those lines.

Tom Hoag N6XB dropped me a note, which read:

"Enjoyed your Web site. I am new to RTTY and have just been on the air for a few days. It's lots of fun. I am using the Hamcomm software, and it is working amazingly well. I can copy RTTY below S1, and that's pretty good!

"I also want to check out the BMK Multy software, but I don't know where to get it. Do you have any info on where to get it, or where the Web site might be? I would like to compare it with the Hamcomm before I decide which one I want to use."

Tom, I am afraid that the only source I had for the BMK software dried up some time ago, so I am at a loss, too. Best I can do now is put this little note in the column, and hope they call me! They do not, to my knowledge, have a Web site. Good luck, and let me know how things work out.

From out of the past, Ron Kinton came upon this find:

"I have a T.U., with no name on the outside, but inside on the PC board there is the following:

'AFSK-CW 800A copyright 1982 DS 11-15-82 DYNAMIC SPECIALTIES.'

"It is not a kit; it has two areas of diode programming for either CW-ID, or some very short messages; is very elaborate, and has not been built cheaply.

"If you have any knowledge of such a thing, and if you know where I could get a manual, I would like to know. I bought this at an estate sale, so cannot talk to the previous owner. I love RTTY, so would like to fire it up and use it."

Can anyone help Ron? I seem to remember this company from ads years ago, but cannot find anything in my archives. Let me know, and I'll pass it along to him.

GreenKeys

And finally this month, a new service about an old medium. Brian K. Short K7ON announces an Internet mailing list called "GreenKeys." This is a mailing list devoted to the discussion of older radio teletype (RTTY) gear including mechanical teleprinters, terminal units, rolls of paper, gears, cams, wing nuts, paper tape, and anything else related to older RTTY gear.

- TTY Machines
- Teletype Corp History
- Maintenance, Preservation
- Buy, Sell
- Sources of Supplies
- Terminal Units
- Collectors
- Electrical, Electronic, Mechanical

and

---

most speakers on HF rigs are top mounted, they tend to direct the sound up and back under the dash.

An external speaker pointed toward you will improve your ability to hear the other station. You may also want to think seriously about the type of microphone to use. If you have two rigs in the car, I can guarantee that two handheld microphones will manage to get their coiled cords tangled together. This is not something you'll wish to deal with during rush hour traffic. Some people mount a small boom microphone to the left of the driver's visor so it can be positioned in front of the operator. Others like a microphone mounted on a headset; as I've mentioned before, if this is your choice it's best to use a headset with only one earpiece so you can hear sirens, train whistles, etc.

In order to protect my rig from coffee spills, and to make it less visible when the car is parked, I use a piece of cloth that approximates the color of the car's carpeting to cover the rig. A piece of plastic under the cloth gives added protection. For small rigs, disposable shower caps such as those found in hotel rooms work very well, and the elastic edge helps keep them in place.

HF mobile operations is one of the most satisfying aspects of a tremendous hobby. I enjoy adding "mobile" after my call sign on QSL cards and noting where I was when the contact was made. I also enjoy those times when conditions are right, when I get multiple responses to calling CQ as a mobile. It may not be a true pileup, but it's enough to make it extra fun for me. 73

Number 63 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Shake up the ether

For the last several months, we've been a little off the ham radio topic with our exploration of video technology. This time, let's get back to the shack and look at something closer to home: RF transmitting circuits.

As a ham, you studied long and hard to earn your license. Let's face it, there's basically only one reason why radio should require that kind of certification: You can transmit!

With the privilege of sending electromagnetic waves into the environment comes the necessary responsibility for doing it right. That means not interfering with other services, using only the prescribed bandwidth, and, of course, not hurting anybody.

Back when hams built their own gear, they had to know much more than we do today before they could get a station on the air. For instance, a thorough knowledge of tank (resonant L/C) circuits, among other things, was crucial to avoid transmitter parasitics (nonharmonic, higher frequencies riding on the carrier) and overly wideband operation. Various factors, such as the tank's Q ("quality factor," or ratio of inductance to resistance) had to be taken into account to get things working just right, or all kinds of bugaboos could result. For instance, did you know that a transmitter's output stage can act as a mixer, reacting to signals coming down the antenna wire from other transmitters, *while it's transmitting?* It sounds crazy, but it happens. Perhaps the most common example of it is "intermod" on a repeater.

Lots of hams call darned near any repeater interference "intermod," but true intermod is more than simple interference; it's the result of mixing of the transmitted output with some signal picked up from another transmitter, and it occurs because the interfering signal overloads the output stage, driving it into nonlinear operation, thus making it into a mixer. In effect, the repeater transmitter's final amplifier is acting like an overloaded receiver! It takes a lot of signal to do that, but there often is plenty of stray RF up on those hillsides where most repeaters live alongside other powerful transmitters.

These days, anybody with the money for a factory-built radio can get on the air simply by

Continued on page 74

• Anything Else RTTY-Related

This is not intended as a "contest" reflector as this aspect of RTTY is already quite well served.

To join the mailing list, send E-mail as follows:

TO: majordomo@qth.net
SUBJECT:
BODY: subscribe greenkeys

To be removed from the mailing list, send E-mail as follows:

TO: majordomo@qth.net
SUBJECT:
BODY: unsubscribe greenkeys

To post to the mailing list:

TO: greenkeys@qth.net

This reflector is sponsored by Al Waller K3TKJ and is maintained by Brian K7ON. I'll keep an eye on the list, and see if anything of interest appears.

I guess that about brings this edition of RTTY Loop to a close. Remember to check the RTTY Loop Web site at: [http://www2.ari.net/ajr/rtty/].

You can also drop me a note at ajr@ari.net, or even by snailmail at the above address. You can see that I not only read what you write, I actually appreciate it, and use it! So, drop me a note, and we'll see what develops.

Ham Radio Fun

My Strange QSO

Mysterious voices and guarded messages—a typical Sunday afternoon in the Midwest?

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

It was a cold gray Sunday afternoon, one of those winter afternoons when everyone in the northern latitudes is content to stay indoors. I had finished talking with a friend in the South Pacific on 15 meters, a schedule that we tried to keep each Sunday afternoon. The band seemed to be exceptionally quiet; not many other stations anywhere on 15. I wondered briefly. but thought oh, well, count your blessings—at least there was no QRM, and signals between the South Pacific and Chicago were very readable. My friend and I'd had an enjoyable QSO. We had often joked about there being an ionospheric pipeline between our homes 6,000 miles apart, we enjoyed Q5 signals so often. We had just signed with each other when I heard another station calling on the frequency that we'd been using. He must be calling Brian, I recall thinking, no one ever calls 9-land for a DX contact!

I listened for a few seconds, just for fun, to see who was calling him. Then I heard it: "This is Alpha Charlie One calling NZ9E. Over."

Alpha Charlie One? I kept listening, not really knowing how to reply. My DX friend didn't come back to the mystery station either.

"This is Alpha Charlie One calling NZ9E, do you read me? Over."

No mistaking it this time. He'd said "Alpha Charlie One" and my correct call. I remembered from studying the FCC rules and regs that it was illegal for licensed hams to talk with unlicensed bootleggers, and this sure seemed to fit that bill! I hesitated again, but the same call was repeated once more:

"This is Alpha Charlie One calling NZ9E, do you read me? Over."

Curiosity finally got the best of me. I keyed my transmitter and returned with "Alpha Charlie One, I think you said, this is NZ9E. Are you a ham operator?"

"No," was the reply, "I'm with the US military in **** (Central America). How do you copy me? Over."

> ***"Are you sure you're supposed to be on this frequency?"***

The US military? Why was he calling me? "Yes, I'm copying you well enough," I responded. "Are you sure you're supposed to be on this frequency? This is the 15-meter amateur radio band."

"It'll be okay," he said, "I need someone to pass on a message for me to my headquarters in the states. Can you do it? Over."

I felt that I was getting in too deeply at this point—perhaps I should have just ignored his call in the first place. But then, maybe it would be wrong to just throw the big switch and leave now. Trying to think this out on the run, and not leave too long a pause between his transmission and mine. I answered, "This is NZ9E. I don't know, are you *sure* that this is okay?"

He came back with "It's okay—I can't make contact to the states on my normal radio channels. That's what I want you to pass along. Will you help me? Over."

I've never cared much for that "over" business—sounds too military or too Hollywood, but since he was used to it, I decided to comply. "You want to me contact someone here? Aah, over," I said.

"Yes, I'd like to have you place a phone call to my base commander and give him a message, over."

"Well, all right, give me the phone number and the message," I told him.

He gave me the number to call and asked me to tell them that the nighttime frequency was not getting through, but to use the daytime frequency instead; that he would be listening on the daytime frequency beginning that evening.

"Who am I calling and where are they located?" I asked.

"Can't tell you that," he said, "but promise that you won't stop trying to get through until you've passed the message personally," and he gave me the name of the colonel with whom I was supposed to make personal contact.

Great, I thought, now I don't even know what I'm passing along or exactly to whom!

"Can you promise me that? Over."

"I suppose," I answered. "You're *sure* this is legal? Over."

"It's okay," he reassured me once more, "but please assure me that you'll get through no matter how long it takes."

"Yes, yes I will," I promised. What else could I do at this point? "Alpha Charlie One (what am I doing using this goofy call?), this is NZ9E, I'll pass the message for you, QSL? ...errrr rather, do you copy? Over."

"Yes, I do, NZ9E, and thanks a lot for your help. It's important. Alpha Charlie One clear."

"Right, understand, NZ9E is also clear."

I sat way back in my chair and stared at my rig for several minutes—what had I promised to do?

I turned off the gear and walked slowly upstairs, still not quite sure what had happened or how I'd managed to get involved. I wondered if my friend in the South Pacific had heard any of that exchange. We didn't have another schedule until the following weekend, so I couldn't even ask him what he had thought of all of that. It looked like I was on my own on this one.

I found my wife Sue (KA9UCK) in the living room reading the Sunday paper. She asked me how my schedule went.

I told her, "Fine, Brian says hi," then I told her about the strange ending to our QSO.

She asked me what I was planning to do. I told her I wasn't quite sure yet, I was still a bit confused from the unusual conversation. She said I'd have to pass along the message—I had promised I would. I agreed, but also brought up the fact that I wasn't sure how legal it all was—was this guy really US military or some terrorist or drug runner—or? Too much TV and too many spy movies, I suppose.

"Is there anyone you can call and talk to about this first?" she asked.

"Like who?" I said almost absent-mindedly.

"How about the FCC?" she offered.

"What if what I did was illegal?" I countered.

"Well, it wasn't like you did something illegal on purpose," she reasoned. "You couldn't just ignore the call, could you?"

"No, I suppose not," I said, "but how is the FCC going to know if this fellow was on the up and up or not? I don't even know."

We talked about it some more and she convinced me that I should keep my word, but also report any suspicions that I might have to the authorities.

I thought a lot about that through the rest of the day. I also called the number that Alpha Charlie One had given me, but the phone rang and rang with no reply. I was actually relieved. I didn't really *want* anyone to answer.

The next day, Monday, I woke up still thinking about the previous afternoon. I had pretty much decided what to do.

I was going to call the FBI and see what they thought about it—pass the buck, so to speak. I had been part of a TV crew that had done a piece on the Chicago FBI office a year or two before this incident, so I thought I'd feel reasonably comfortable talking to one of their agents. They were pretty nice guys, the ones I'd met while taping the show. I would tell them my suspicions—Central America, drugs, terrorists, guerrillas, etc.—and see what they advised me to do. Good plan; that's what I'd do. After all, the radio signals crossed state lines—heck, international boundaries! Maybe I should call the CIA instead? No, the FBI had been in less hot water—so the FBI it was.

About 10 a.m. I telephoned directory assistance and was given the telephone number for the FBI's Chicago office. Nervous, and not wanting to come across as a kook or crackpot, I dialed the number. I'm getting in too deeply, I kept thinking. I managed to convince the receptionist that I was a concerned citizen and felt that I should speak to a special agent. That's what they call themselves, Special Agents. I learned at least that much about the FBI during the TV piece we did! She eventually put me through. I told the agent that I was an amateur radio operator and briefed him on what had transpired during my conversation with Alpha Charlie One the day before. He was a really nice chap and he even understood something about ham radio. He seemed to know that I wasn't off my rocker, but rather that I was genuinely concerned about not aiding and abetting anything contrary to our country's international position. He told me that he knew of no reason why I shouldn't make the call as requested (nothing was particularly sensitive in that Central American country right at that time), but he asked me to pay close attention to everything said during the conversation with the party that I was asked to call, then call him back and let him know how it went. I thanked him for his help and advice, and we hung up.

Yes! (One of those yeses that kids use today when they feel they've accomplished something worthwhile or passed the buck!) It seemed like maybe I was off the hook! As long as I had the FBI on my side, could I wander too far astray? I called the number given me by Alpha Charlie One with renewed confidence.

You know how sometimes you'll hear switching transients when your phone call is routed through a complex internal network? Well, it seemed like I was taking the long way to Mars on this call! Switching pulse after switching pulse … it went on for at least half a minute. Where the heck was I calling? Finally a female voice. She spoke so fast that I'm not actually sure what she said, but it sounded governmental—maybe even military! After explaining everything to her in excruciating detail, she said that she would take the message and pass it on. I told her that I had promised the sender that I would give the message to the colonel personally, and that I felt that I was morally obligated to do that. She was reluctant, but handed my call off to someone else. Don't you love when that happens? Another complete explanation, I still wasn't talking to the named colonel, but maybe I was getting closer. Fade back for a pass; pass received. I found myself talking to still another unrecognizable name, still not the colonel, but still getting closer! One more pass and reception and I was at least in the colonel's office, apparently talking to his secretary. It was getting harder and harder to gain yardage the deeper I got into the maze, but I was finally able to break through their defense line and go for the touchdown. I was over the goal line, finally talking to the colonel himself! Great! Just one more complete explanation!

He asked me lots and lots of questions, most of which I couldn't answer—such as why did this Charlie Alpha One call me?

I didn't know, of course; I supposed it was simply because I was there, on frequency, and I was the only one he heard at that time. Lucky me! The colonel was very reserved as to what information he was willing to give me to satisfy my own curiosity, and I was cool enough not to ask too many questions, but I knew that he was relieved to receive the message. Obviously, he knew who Charlie Alpha One was (though he never actually said so!). At the end of this rather strained conversation (from my standpoint), he asked me if Charlie Alpha One had told me anything more about his mission. I said "No."

The colonel said "Good!" He thanked me for calling and we hung up. I called back the FBI agent I had spoken with earlier, as promised, and told him what had transpired. He said that he was satisfied that it was nothing for me to be concerned about any further, thanked me and hung up.

The following Sunday afternoon, I asked Brian (my DX friend) what he thought about my strange QSO with the Charlie Alpha One? He hadn't listened—he'd tuned off the frequency when he heard that the call was for me. The Charlie Alpha One call hadn't really registered with him at the time either.

So that's pretty much the whole story … at least as much of it as I feel free to tell. I've only held back on some of the specific identification details. To this day I've never heard any more from anyone involved. Not even a QSL card! I watched the news more intently in the following weeks, but never saw anything that might have been even remotely connected with my strange QSO. I doubt that I'll ever know the whole story, but maybe that's for the best. It's more fun to imagine what it might have been all about. Who says there's no adventure left in ham radio? I doubt that the Internet could match it!

Postscript

In a later conversation with another ham friend, one who had been in the communications branch of the military, I was reminded that all of the frequencies (including our beloved ham bands) actually belong to the DOD, the Department of Defense. The DOD loans the frequencies out to the FCC to dispense to the civilian population during times of peace, but they're still DOD's when needed in an emergency. It makes sense: What's more important than defending our country and keeping America free?

RF Voltage and Power Meter

Going up? In power, that is? Find out with this easy-to-build instrument.

Randy Henderson WI5W
10809 NE 17th Street
Oklahoma City OK 73141

I'm sure you want to communicate effectively to get the most enjoyment out of your hobby. Whether you are using QRP power levels (under five watts) or the legal limit, measuring the output power of your transmitting equipment provides some assurance that your signal has a good start in overcoming the vagaries of propagation.

Many stations don't have instruments capable of indicating forward and reflected power at the same time. Build this project and you can use your present SWR meter to continuously indicate reflected power while this one reads forward power. With a little care, you can make it capable of accurately indicating output power, too.

A roundabout method

Most amateurs use instruments which measure power indirectly—current in the transmission line is often the quantity being measured. If the indicating device is a meter, the scale will be calibrated in watts instead of amperes.

This is possible as long as the load resistance is known. It is usually assumed to be 50 to 52 Ω. Whether the measuring circuit is in your rig or in an external unit, this technique is usually implemented in a way convenient for measuring reflected power.

In addition to requiring more complicated construction, the usual method uses some type of transmission-line transformer or current transformer which will only work at radio frequencies. An accurate source of RF power at various levels is necessary to calibrate such instruments.

The measuring system shown here can be calibrated with an inexpensive DC voltage source. You can probably find many of the components in your junk box. It is an easy and inexpensive project. For accurate power measurements, the load seen by the transmitter must be a known value (as is also the case with current-based measurements).

Because peak RF voltage is being measured, you can connect a source of known DC voltage for calibration purposes to this circuit without the customary 50 Ω load. It is not necessary to send large amounts of power to the load. A voltage reading is just as valid when taken across a low-power (high-resistance) load as when read across a high-power (low-resistance) load.

If we are talking about DC circuits, power is related to voltage and resistance by **Equation 1**: $P = E^2/R$.

Power (P) is equal to the voltage (E) squared divided by the resistance (R).

The basic units for this relationship are watts, volts, and ohms.

We can also use this relationship with RF voltages. Your transmitting equipment will produce an output signal with a sine wave shape. It does not contain the same amount of power as a DC signal with the same peak voltage. To convert the peak RF voltage to a value equivalent to DC of the same power level, multiply it by 0.707.

The reason for discussing peak voltage is because a simple rectifier circuit can be used to detect the peak voltage of the RF waveform. The schematic in **Fig. 1** shows how the transmitter output voltage is reduced by a voltage divider made of R1 and R2 before being rectified by diode D1.

Reducing the voltage applied to the diode is necessary because it would be destroyed by high-power operation if connected directly to the transmission line. Diodes capable of withstanding high voltage have relatively slow switching speeds and other characteristics which make them unsuitable for this application.

Pesky parasites

Unfortunately, parasitic capacitances can cause the response of this circuit to vary when used over a wide frequency range such as 1.8 to 30 MHz. This effect is represented by Cp and Cp′. These are not actual components. They represent the capacitances that exist between various parts such as component bodies, leads, the diode junction, and the enclosure.

Often, Cp′ will be large enough to reduce sensitivity as the frequency is increased with all other factors being constant. You can, however, correct this shortcoming by using the correct value for Cp.

In **Photo A**, the parasitic capacitance Cp is increased because the ends of R1 are brought close to each other. R1 is actually made of 4 resistors for increased power rating. Two parallel resistors are in series with two other parallel resistors, all being of the same value.

Final adjustment is made by bending leads of the resistor bodies composing R1 farther from or closer to the enclosure bottom formed by the copperclad board. This effectively adjusts Cp′.

Another way to adjust for a flat frequency response is to make Cp variable. You can do this by soldering a short pigtail to the input end of R1. To increase Cp, bend the end of this lead closer to the opposite end of R1.

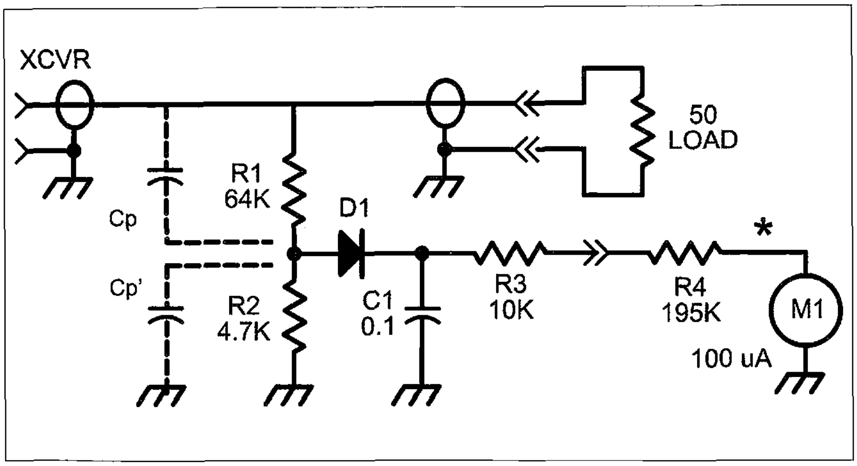


*Fig. 1. Four half-watt resistors make up R1. R2 is 1/4 W or larger. *R4 can consist of several individual resistors in series or series/parallel combination to achieve the required value. Another possibility is to use a fixed resistor and a variable one. In this example, a 180 kΩ resistor in series with a 30 kΩ pot could be used. D1 is a 1N34A (available at Radio Shack™).*

One alternative for alleviating the effects of parasitic capacitance is to use much smaller values for R1 and R2. If R1 and R2 have much lower resistance values, perhaps by a factor of 10, the reactance caused by parasitic capacitance is relatively inconsequential at HF. Unfortunately, power dissipated by the resistors will be much greater. At an RF output level of 1000 W into a 50 Ω load, R1 and R2 in **Fig. 1** would dissipate more than 7 W total if their values were reduced this much. Other complications such as parasitic inductance and unwanted inductive coupling can also enter the picture if you choose this route.

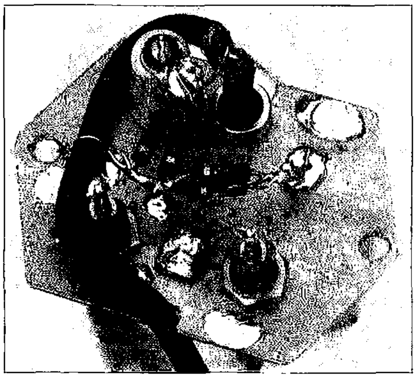


Photo A. *R2 is hard to see in this photo, but it is soldered to the ground plane. R1 consists of the four 1/2 W resistors, with two of them connected to the solder lug atop the cone-shaped ceramic insulator. A small square of copperclad board is cemented to the ground plane and supports the junction of D1, C1, and R3. A short piece of hookup wire soldered to the ground plane secures the RG-58 cable.*

To find out if the circuit has a flat frequency response over the intended range, you need an RF signal source and some method of ensuring that signal levels are the same at both ends of the range.

For a flat response from 1.8 to 30 MHz, you need only a relative reading at both frequencies. An absolute reading is not necessary at this point. Just make sure the two readings are equal.

Wait a minute: If you already have a power meter, why build another one? One reason is that you can use your existing gear to help calibrate an instrument capable of making reasonably accurate measurements at higher power levels.

Suppose you have a 100 W rig and decide to acquire an amplifier. Older amps and home-built ones may not have an absolute indication for power output or you may need something such as this project as a standard. Similar problems may exist for amplifiers made to boost QRP rigs to higher output levels.

In the above case, you could use an HF transceiver as the source as long as you have a power meter (calibrated or relative, internal or external) with a flat frequency response. Most power metering circuits will have a relatively flat response. Some instruments commonly known as "Monimatches" are made for measuring only SWR. They have a rapidly increasing response with increasing frequency, and are not suitable for this particular test. If you're not sure, you can modify **Fig. 1** to use it for this purpose.

To modify **Fig. 1** for testing the high- and low-frequency signals of your source, simply solder a short wire jumper across R1. The circuit is now suitable for measuring outputs of up to about 25 W. Use this arrangement to test or adjust your RF source to ensure that equal power levels are obtained at both test frequencies. This is possible because the reactance caused by parasitic capacitance Cp′ is negligible compared to the 50 Ω load.

If the RF source is difficult to do this with because of varying output levels, you could make a temporary or even permanent version of this modified circuit for low-power testing. Leave it connected to the load as you test and adjust the high-power RF voltmeter for a flat frequency response.

I used a 100 μA meter movement for M1. When you are adjusting Cp′ by positioning resistors, temporarily use a value for R4 that provides a deflection of at least half-scale or more for M1. Small changes in response will be easier to read in this way.

Suppose the power level when adjusting Cp′ is 20 W. This would correspond to a peak voltage of approximately 44.7 V. For a full-scale meter indication at 50 V peak, the total resistance of D1, R2, R3, R4, and the meter movement should equal 500 kΩ.

Alternatively, you can use a multimeter set at the appropriate voltage scale in place of M1. Analog multimeters are fine for this purpose and digital ones are even better. Remember to test with any cover in place over the rectifier circuit because it will affect Cp′.

Once you have the rectifier circuit set up for a flat frequency response, it can be calibrated to measure actual power levels. As I mentioned previously, you can use a dedicated meter movement or use a multimeter connected at R3.

A double-checking doubler

My RF voltage/power meter is calibrated for a full-scale reading at 1000W. This means that it is at full-scale deflection (the 100μA indication) at 316.4 peak RF volts as well as DC volts. I used the AC-powered voltage doubler in **Fig. 2** constructed breadboard style to adjust R4 for the proper reading. Actually, you can calculate the value needed for R4 using Ohm's Law and Equation #2. However, this procedure helps double check the results in the event component tolerances cause errors.

Do not connect the 50 Ω dummy load for this part of the test. The little voltage doubler is not designed to supply 2000 W to the dummy load!

The voltage divider composed of R1 and R2 in **Fig. 1** will reduce 316.4 V to about 21.65 V. With the additional 100 μA current drawn by the meter movement, it will be reduced even more to about 21.2 V. For a full-scale reading at 100 μA with 316.4 V, the total resistance of D1, R3, R4, and M1 should be 212 kΩ. Actually, it may have to be slightly lower because of individual diode characteristics. The meter current in **Fig. 1** causes the circuit to be a less-than-perfect peak detector.

In the event that you simply haul some parts out of the junk box to construct this circuit, the calibration procedure is a pretty good way to make up for imprecision in several areas. This is the reason R1 was 64 kΩ in the prototype (a nonstandard value) instead of 62 or 68 kΩ. The resistor tolerances were rather wide.

Alternatively, using precision 1% resistors will yield reasonably good results if you don't have a means of making very accurate resistance or high-voltage (DC) measurements and M1 itself is accurate. Calculating the voltage at the top of R2 is easy as long as you don't have to contend with the meter current. Adding the meter current complicates things because the voltage divider is now altered. To calculate the voltage across R1 use **Equation 2**: $E1 = [(Et \times R1) + (Ib \times R2 \times R1)]/R2 + R1$.

E1 is the voltage across R1. E2 is the voltage across R2. Ib is the meter current. Et is the total voltage across the resistor string—in other words, at the transmission line. Finding the voltage across R2 is simply a matter of subtracting E1 from the total voltage, as in **Equation 3**: $E2 = Et - E1$.

Fig. 3 is a simplified representation of **Fig. 1**. There are effectively only three current paths for the rectifier circuit in this project: Ia, Ib, and It. Yes, a current path exists through the dummy load. It loads the voltage source for the transmission line, but otherwise has no effect once you know the transmission-line voltage.

Rm represents the total resistance in the series path supplying meter M1. Analog D'Arsonval-type movements may have a resistance of several hundred to maybe 3,000 Ω. Most digital voltmeters have an input resistance of 10

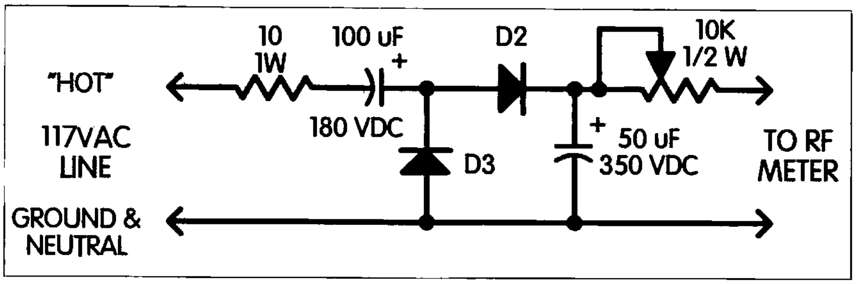


Fig. 2. This voltage doubler circuit can be used to check calibration of the RF voltage/power meter. D2 and D3 can be a 1N4005, 1N4006, or 1N4007. Adjust the variable resistor for 316.4 V at the transmission-line terminals if you want to simulate the peak voltage of a 1 kW sine wave into a 50 Ω load. Component values are not critical. Just be sure to use voltage and power ratings at least as high as those listed and use extreme caution with the high voltage.

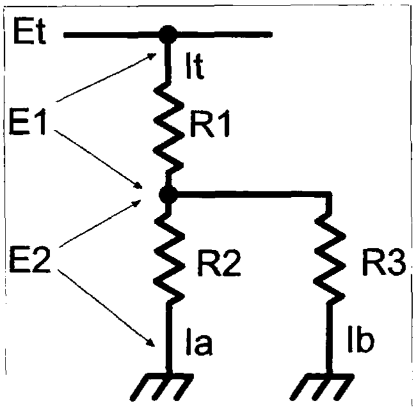


Fig. 3. Most of the problem in determining E1 involves finding the current in R1 by substituting equivalent expressions for It.

megohms. If you use a digital voltmeter, that is high enough to treat R1 and R2 as a simple voltage divider instead of using **Equation 2**.

The current path through R2 is represented as Ia and current in Rm (the meter circuit) is Ib. These currents are combined in R1 as It. After finding E1, E2 is the difference between Et and E1, so you can simply divide E2 by Ib to find Rm.

I mounted all of the rectifier circuitry on a small piece of copperclad board. This includes a PL-259 plug and two binding posts for attaching the meter leads in **Photo B**. The PL-259 plug is mounted by tightening an RG-58 cable adapter against the board after inserting it into a slot cut for this purpose.

Referring back to **Photo A**, the connection between R1 and the transmission line is made very close to the PL-259 by carefully splitting the coax. The shield braid is left intact. A Mouser stamped steel box serves as a cover.

The meter movement is housed in a painted wooden box. **Photo C** shows how everything is assembled, with the RF rectifier assembly connected to a dummy antenna.

I usually use it to monitor output continuously by screwing it directly onto the output of the SWR meter that goes to the antenna system. If the SWR reading is close to 1:1, the power reading should be reasonably accurate.

If, however, several feet of coaxial-cable jumper separate your SWR (reflected power) meter and rectifier assembly, the RF voltage/power meter could be indicating a voltage developed across something other than 50 Ω. This is especially true with some antenna systems on the higher bands.

Some summation

Don't get lost in the details. They are here to provide options. If you don't want to (or can't) adapt the circuit to your individual requirements with one method, perhaps another will work.

To recap, the main idea is to make a resistive voltage divider which feeds an RF-voltmeter circuit. We compensate for parasitic capacitance to make sure the voltage divider has a flat frequency response across the desired frequency range.

Next, we set up the meter circuit so that it reads full scale at a voltage corresponding to the peak voltage of an RF sine wave at a chosen power level. In this example, the level is 1000 W, although lots of other power levels could be chosen. You might pick 150 or 1500 W.

You can design the meter circuit empirically by testing its response to an accurately set voltage (RF or DC), or carefully compute and select resistor values to use with an accurate meter movement or DVM.

Even relative measurements are quite useful if you end up with less than accurate results. I can remember occasions when I was blissfully unaware that the low SWR reading was *not* because of a well-matched antenna system (dead mike, keying with drive turned down, etc.).

This RF voltage/power meter has proven to be a valuable addition to my shack for both testing and general operating. You'll benefit from yours, too!

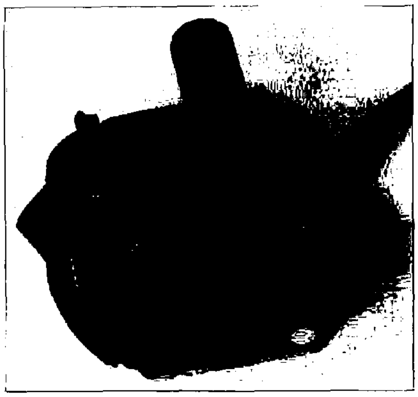


Photo B. A PL-259 connector and two binding posts allow convenient connections to the load and meter leads.

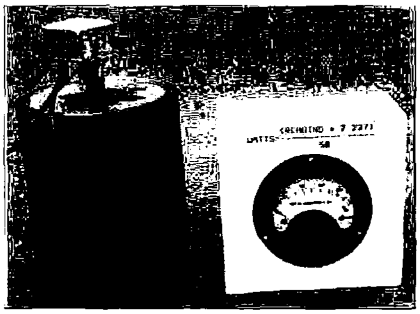


Photo C. The meter can be placed at a convenient distance from the rectifier circuit. The legend on the meter box which reads "WATTS = (READING x 2.237)²/50," results in the following correlations: 10 µA = 10 W; 20 µA = 40 W; 40 µA = 160 W; 80 µA = 640 W; and full scale = 100 µA = 1000 W. RMS voltage equals 2.237 multiplied by the reading. The box covering the rectifier assembly is a Mouser #537-MO18-PLTD.

NEVER SAY DIE

Continued from page 45

look over my guide to books you're crazy if you don't read—there are several excellent ones on raising children. Like *The Prenatal Classroom*, which explains how you can teach your child around 100 words before it's born, thus giving it a substantial head start in learning. And how you can instill a love of good music, too.

Magnets

I presume that despite my reviewing two books on magnetism in my editorials, and then including them in my guide to *Books You're Crazy if You Don't Read*, that you haven't bothered to do any homework on magnetism.

The Rawles and Davis book, *The Magnetic Effect*, published over 20 years ago, cites many experiments where seeds were put over the north and south poles of magnets. Seeds exposed to the north pole energy grew slower, developed thinner plants and poor fruits and vegetables. South pole energy resulted in vigorous growth and bigger, sweeter fruit.

It turns out (surprise!) that magnets have a similar effect on humans and animals. A good friend of mine, who is an expert on magnets, visited recently and when Sherry had a sore knee and elbow from bursitis, taped two small magnets to the affected areas when she went to bed. The next morning the pain and swellings were gone and haven't come back!

By the way, when it comes to plant growth, you can have a profound effect on the growth of seeds and plants by either loving or hating them. If you tell some seeds that they are no good, that they are ugly and never will be any good, you'll get slow growing, stunted plants. If you tell them what fantastic seeds they are, that they are going to grow high and strong and produce beautiful flowers or vegetables, you'll get just that.

Hey, read *Secrets of the Soil*, it's in my guide! Music helps plant growth too.

Continued on page 79

Variable Current Load Bank

A bright idea for testing power supply parameters.

Dave Evison W7DE
153 Park Avenue
Palo Alto CA 94306

Few of us would tempt fate by playing Russian roulette with a loaded revolver, but we play a similar game of chance with our solid-state rigs when we connect them to untested power supplies. Simply measuring the unloaded output voltage of a power supply is not enough. The sharp drop or rise of output voltage from a poorly regulated supply can cause serious damage to equipment operating from it.

This article describes a simple, inexpensive load bank—along with a brief discussion of power supply tests and measurements—for performing confidence tests on power supplies *before* connecting them to your equipment. The scope of this article is limited to 12V to 15V DC power supplies, and to tests that require a minimum of test equipment.

Most amateur power supplies can be checked quite effectively using three simple tests: load regulation, line regulation, and ripple.

Load regulation

Testing load regulation and ripple involves supplying a calibrated load to the power supply. While a simple load bank can be built using an assortment of high wattage, low resistance resistors or rheostats, there is also a simple junk box solution (for 12V to 15V supplies)—use automobile lamps. They are available at any auto supply store or service station, cheap, easily replaced, and come in a wide assortment of power ratings.

Fig. 1 illustrates a simple load bank using readily available automobile brake/stop lamps. While only three lamps are shown, more can be added as needed. The lamps selected have two filaments in each envelope. One requires 0.6 amps (this is the tail lamp element) and the other 1.8 amps (the brake light element). As shown, the load bank will supply loads of 0.6 to 7.2 amps in twelve 0.6-amp steps (see **Table 1**).

There are some trade-offs when using lamps for loads. The first is that an incandescent lamp has a positive temperature coefficient (its resistance increases with heat). Therefore, when voltage is first applied there is a great inrush of current because of the low resistance, but the filaments heat up quickly and the power supply should tolerate this low duty cycle overload.

However, some industrial power supplies incorporating crowbar protection may respond to the rapid inrush of current as indicating a short circuit, and they will shut down the output to protect the supply. It is my personal opinion that such power supplies are not suitable for amateur use because of the rapid and heavy current demands of CW operation. And in this sense, the lamps provide a rigorous test for just such operation.

The second problem is the very bright light developed by the lamps' doing what they were designed to do. This

Load Switch Settings							
Switch	#1	#2	#3	#4	#5	#6	
Current (A)	0.6	0.6	0.6	1.8	1.8	1.8	Total Current
	1	0	0	0	0	0	0.6A
	1	1	0	0	0	0	1.2A
	0	0	0	1	0	0	1.8A
	1	0	0	1	0	0	2.4A
	1	1	0	1	0	0	3.0A
	0	0	0	1	1	0	3.6
	1	0	0	1	1	0	4.2A
	1	1	0	1	1	0	4.8A
	0	0	0	1	1	1	5.4A
	1	0	0	1	1	1	6.0A
	1	1	0	1	1	1	6.6A
	1	1	1	1	1	1	7.2A

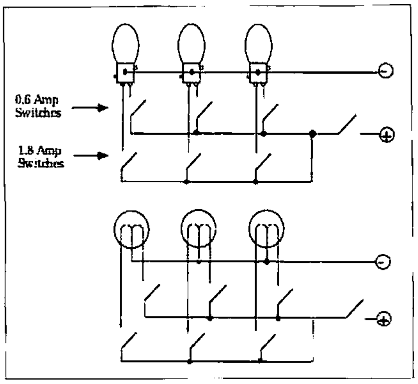


Fig. 1. Diagram and schematic.

problem can be managed by placing the load bank out of direct view, or wearing sunglasses, etc. But there's even a plus to the light situation: You *know* when the lamps are loading the power supply, even without an ammeter in the line.

Let's define the measurements we will be making. Load regulation deals with the change in output voltage from a no load to full load situation (and expressed in percentage of change). A power supply suitable for amateur use should regulate to within at least 10%. For example, if a power supply delivers 14 volts without a load, and drops to 12.6 volts while supplying full output current, the regulation (as a percentage) would be calculated as follows:

% Voltage Regulation = 1 - (FL/NL) x 100

where

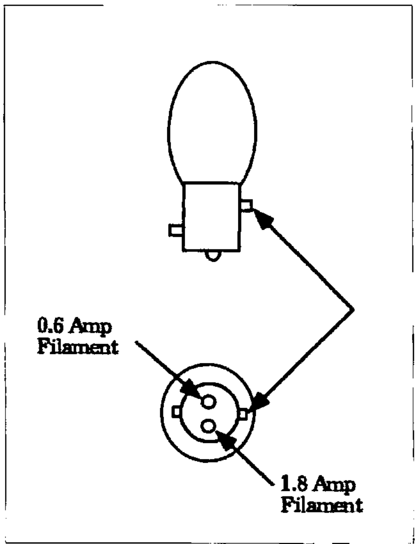


Fig. 2. Type 1034 pinout.

NL = Voltage output with no load
FL = Voltage output while supplying full load

thus
% Voltage Regulation = 1 - (12.6/14) x 100
% Voltage Regulation = 10

Line regulation

Line regulation deals with the change in output voltage with a change in line voltage (generally ±10% change in AC input). This measurement is generally performed with the supply delivering maximum rated output current. A power supply suitable for amateur use should line regulate to within 5% or better. For example, if a power supply delivers 12.6 volts at full output current with the line voltage set to 132 volts AC, and delivers 12.0 volts at full output current with the line voltage set to 108 volts AC, the line regulation would be calculated as follows:

% Voltage Regulation = 1 - (LL/HL) x 100

where
LL = Voltage output at full load with line voltage set to 108V AC
HL = Voltage output at full load with line voltage set to 132V AC

thus
% Voltage Regulation = 1 - (12.0/12.6) x 100
% Voltage Regulation = 4.8

Ripple

Ripple (or hum) is measured at full output load and generally expressed in AC millivolts. The less ripple the better! Even for amateur use, the ripple reading should be less than 0.5%. For example, a power supply delivers 12 volts DC at full load and its ripple measures 60 mV rms. Although this is 0.5% of the output voltage, 60 mV can cause a lot of grief around high-gain audio amplifiers (and especially direct conversion receivers!). *Important:* If the power supply being tested is a switching type, a minimum load must always be applied or it will not function. Therefore, the regulation test should be from *minimum* load to full load.

"The less ripple, the better!"

A typical test setup for performing load and ripple measurements is shown in **Fig. 3**. Notice that the digital voltmeter is connected directly to the power supply terminals for maximum accuracy because of copper losses in the test setup wiring. Determining the load burden based upon **Table 1** will be close enough for most applications. However, if you use the lamp load bank to test lower voltage power supplies (such as 5V or 9V units), an ammeter should be used.

Another thing to keep in mind is that regulation specifications interact. For example, varying line voltage (perhaps from a portable AC generator during Field Day, or a long extension cord, etc.), combined with the load regulation, can result in severe regulation swings. And, of course, take into account the copper losses of the cable from the rig to the power supply and the resistance of inline connectors. You should either minimize all of these factors, or hope you never experience a worst case event!

While there are a lot of other meaningful power supply specifications (such as recovery time, regulation overshoot, etc.), simple regulation and ripple tests are adequate for most amateur applications.

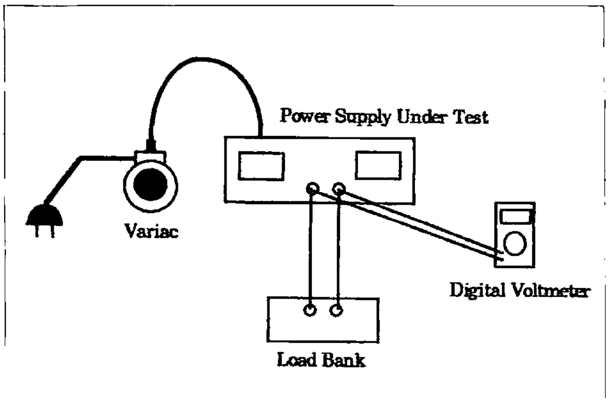


Fig. 3. Regulation/ripple test setup.

KABOOM

Continued from page 63

stringing a dipole in the trees. There's nothing wrong with that, but it's led to a near loss of the "art" element of radio. The days of fiddling with vacuum tube neutralization and such are pretty much over. So, in the interest of keeping the art of radio going, this month, I thought it would be fun to explore transmitters and their quirks.

In the beginning

Before you can send a signal out from your antenna, you have to make one. A signal, that is; I'm assuming you already have the antenna! How the RF is generated varies greatly by the type of RF you want to make. FM, AM, SSB, CW, VHF and UHF all have different methods of generation. To generalize, though, the process requires one or more oscillators, a modulator of some kind and an amplifier or two.

CW

It's easy to generate RF using a one-stage oscillator, and zillions of transmitters have been made that way. In fact, with tubes, it wasn't hard to get a few watts right out of the oscillator, with no further stages of amplification needed. Back when CW was the dominant mode, all it took was a key, a few coils, resistors and capacitors, one tube and a way to power it, and you were on the air! Even in the modern, solid-state age, single-stage transmitters are still being built by QRP enthusiasts. Most transistor oscillators don't put out much power, though, so a lot of QRP rigs employ a stage or two of amplification before the antenna.

To generate CW, all one has to do is key the oscillator on and off. Well, sort of. Such crude keying works decently only when the oscillator is very stable. If it isn't, it'll "chirp," or slide in frequency as the power goes on and off. Most crystal oscillators can tolerate power keying, but even some of those get ugly with that method. A far better way to key a CW transmitter is to leave the oscillator running and key an amplifier stage following it. That lets you tailor the keying curve to avoid "key clicks," which are unwanted sidebands caused by the rapid transitions of the key's on and off states. A capacitor or two can easily damp key clicks by "softening" the transitions (slowing them down), but such softening plays havoc with oscillators, so it's rarely used in single-stage designs which key the power going to the oscillator. Now and then, you can get away with it when the oscillator is crystal-controlled.

In a modern multistage radio, keying is much more complex than a simple on/off signal. A typical HF rig has a pretty involved keying circuit which sequences various operations each time you press the key. First, the synthesizer's VFO is put on the correct frequency. Remember, it could be a few hundred hertz off (due to the receiving offset), or it could even be on another band if you're operating split. Once the transmitter is on frequency, the antenna changeover relay (if there is one) is set to connect the transmitter to the antenna, rather than the receiver. The receiver is muted at about the same time. Finally, the RF is applied to the final amplifier and out it goes. Whew! Of course, all this happens very fast, and all you really experience is pressing the key and sending the dit or dah. Still, without this kind of sequencing, things we take for granted, like full break-in and split-frequency operation, wouldn't be possible.

The final amplifier itself doesn't have to be linear to make proper CW. In other words, it can clip and have all kinds of ugly distortion, because all that matters is whether the carrier is on or off; it conveys no other modulation. Why do it that way? Well, it's cheaper and simpler to make a non-linear, or "class C," amplifier, and such a stage is much more efficient than a linear one, too. To make it work, all that's required is a good low-pass filter before the antenna. Remember, all the ugly stuff is at a much higher frequency than the carrier, so filtering out everything above the desired carrier will leave nice clean sine waves, no matter what the waveform originally looked like. In fact, that's how it's done in virtually all CW-only transmitters.

"With tubes, it wasn't hard to get a few watts right out of the oscillator."

AM

Next up the evolutionary modulation scale is AM. This mode shares more with CW than you might imagine! Basically, it's a steady carrier which has its strength, or amplitude, moving in step with the audio (or data, or whatever) you wish it to carry. The actual waveform is spectrally more complex than that, but the method of generation really is that simple. Since the carrier's strength must track the modulation, that would suggest a linear amplifier stage for the output. Certainly, you can do it that way, but you don't have to! In fact, AM can be generated using a CW-style, class C amplifier. All you have to do is feed a steady, unmodulated carrier to the final amplifier, just as you would with CW. The trick is to modulate the final amp's DC power input with the audio itself! As the final amp's power goes up and down, it'll turn that steady carrier into good ol' double-sideband AM. The downside is that you need about 50% as much audio power as RF power. So, for a 10-watt AM transmitter, you need a five-watt audio amplifier. Despite that power-hungry inconvenience, most AM transmitters work that way, including all the AM-only CB sets I've ever seen. It's just cheaper and easier to make audio power than linear RF power. Besides, much of the inefficiency of needing all that audio power is made up for by the efficiency of the class C final RF stage.

FM

In FM, the modulation is impressed on the carrier by wiggling its frequency around a little bit. There's no way to do that once the carrier is already made, so, by definition, FM has to be created at the oscillator level. In other words, it can't be added at the final stage. In a modern rig, FM can be accomplished in various ways. Some radios induce the FM by wiggling the control voltage which drives the VCO. The rest of the frequency synthesizer loop is deliberately made too slow to compensate for such fast changes, so the VCO's frequency winds up wobbling along with the audio. *Presto*, FM. Another way is to phase-modulate the output of an oscillator with a tank circuit that includes a voltage-variable capacitor, or varicap. Although not true FM, phase modulation can be made indistinguishable from FM by using an audio filter in the mike amp. Most HTs use this method.

Yet another full-carrier mode, FM does not demand a linear amplifier. Class C will do fine, because the amplitude of the RF waveform doesn't change at all. In FM, only the carrier's frequency wobbles around as it tracks the modulation, so amplitude linearity is pointless. All of our VHF and UHF FM-only mobiles and HTs use class C amplifier stages. Especially at those frequencies, linearity is expensive and inefficient.

Why?

I keep saying that class C amplifiers are more efficient than linear ones, but I haven't said why. The reason has to do with how amplifiers work: They take DC power and modulate it with the incoming signal, like a gate. In a non-linear amplifier, the bottom of the incoming waveform is allowed to cause the amp to turn fully off, and the top lets it turn fully on. The amp spends practically no time in the in-between state. In other words, it acts like a switch.

A linear amplifier, however, spends lots of time partially on as it tracks the input signal. Thus, the amplifying element (transistor, IC or tube) acts like a variable resistor. We all know how resistors restrict current flow—they turn excess power into worthless heat. So, linear amps get much hotter, wasting lots of power. There are designs which reduce that problem, such as class AB, or "push-pull" amps. No matter what you do, though, the efficiency can never approach that of a class C amplifier.

Well, there's more to discuss, but I've run out of room. Until next time, 73 de KB1UM. 73

Number 75 on your Feedback card

Hams with Class

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Riding the airwaves at camp

One of the fun things about the hobby of amateur radio is that you can never run out of new experiences to have. For the past 18 years I've been teaching "Introduction to Amateur Radio" to 6th, 7th, and 8th graders at Intermediate School 72 on Staten Island in New York. I've always looked forward to having the summer off so that I can "recharge my batteries" and be fresh and enthusiastic for the fall term.

For the past three years, a camp director from a local day camp on Staten Island has been asking me to establish a ham radio program during the summer. An unusual confluence of circumstances this year prompted me to accept the offer. Little did I know what I would be in for.

It's been many years since I've been involved with a summer camp. I had forgotten how unlike school it all is. First was the problem of the location of the station. An old house trailer was completely refurbished for me. Walls were constructed, fresh paint was applied, shelves and a desk were built, new carpeting was installed, and we were ready for the equipment.

Nothing really worthwhile ever happens in ham radio with just one person. It's the nature of who we are and what we do that we interact and help each other. My good friend Marty WA2YYX played a key role in helping to get the station operational.

First, Marty thought that I should have a really distinctive antenna. So he constructed a resonant dipole antenna for all bands out of bright pink wire. I must say it really does stand out in front of the green trees. The kids always look up at it and chuckle as they enter the ham shack. The next purchase was for a Kenwood TS570D HF transceiver and matching power supply and an ICOM IC-W32A 2 m/440 MHz dual-bander. We used an MFJ Morse Tutor along with some Media Mentors code practice oscillators and code audiocassettes. We were all set.

To my surprise I was programmed to receive nine different groups of children every day. The ages of the groups ranged from four years old to 15. Because of the large numbers of children who wanted to come to radio, I got to see each of the 45 groups only once a week. This meant that lots of young people got their first exposure to ham radio this summer. Unfortunately, it was all fun, with very little instructional time—but several of the campers saw me privately about getting more information. I gave them EAD applications from the ARRL, along with my phone number so we could arrange for them to visit a local ham radio club meeting with me this fall.

Photo B. Dan KA2NZV loves to share ham radio with children.

One of the best parts of the summer camp experience was when the ham we were speaking with stopped by to visit the children and give out their QSL cards in person. Marty WA2YYX and Steve KA2HXU were there many times, helping to set the station up and to meet with the children (**Photo A**). Dan KA2NZV made himself available to speak with hundreds of youngsters and to meet with them in person as well. Dan is a New York City detective who is dedicated to showing young people the benefits of our hobby (**Photo B**). My dear friend Brother Joe AC1U from Morrearo, Louisiana, was another ham who was on the radio every afternoon to welcome the children to the airwaves. Jim N2EIY donated a YAESU antenna tuner to us and spoke to many of the campers.

Photo A. Steve KA2HXU (left) and Marty WA2YYX often stopped by to talk with the campers.

There were so many hams who made me proud to be an amateur radio operator because of the warm welcome they extended to the youngsters. I was especially touched when I was able to put some "challenged" young people on the air. It wasn't always easy to understand what they were saying; but so what? They loved coming to ham radio class because they could be good at something and there were always receptive, nice people for them to talk with on the radio. I commend all those hams who knew what I meant when I introduced these "special" groups.

I'm so used to teaching ham radio in the structured format of a school setting all year, that it was really an interesting challenge for me to tackle the camp situation (**Photo C**). Each youngster was provided with a little lap desk and paper and pens. I had a chalkboard along with my radio world maps and globes. The camp experience added another dimension to my ham radio experience. We even had a special JCC Day Camp QSL card made up.

If anyone out there decides to give radio a chance in a camp setup next summer, be sure to contact me. There's no point in reinventing the wheel. I learned a lot this summer, which is usually the case when a teacher really gets

Photo C. All the children loved spending time in the JCC ham shack this past summer.

Number 76 on your Feedback card

Homing In

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
[HomingIn@aol.com]
[http://members.aol.com/homingin/]

Surprise!

Ham radio is full of surprises. Catching a rare DX station as you cruise the bands in the wee hours, suddenly hearing Hawaii on your two-meter handheld when trans-oceanic ducting comes in, discovering an old friend rag-chewing on 10 meters and reliving old times—these surprises make our hobby a joy.

If you like surprises, you'll love hidden transmitter hunting, also called foxhunting or T-hunting. Every time you set out on one of these radio direction finding (RDF) contests, you never know where you will end up, and you usually have no idea what you'll find there.

Surprise endings are common on T-hunts. They are both entertaining and educational. Southern California hiders have many ways to surprise hunters. They bounce signals from mountain peaks and find unmapped roads in the wilderness. Sometimes they camouflage their transmitters inside common objects, then put them in plain sight.

The best T-hunt surprises involve deception. Not out-and-out lying, of course, though some T-hunters aren't above prevarication while the hunt is in progress. By deception, I mean the same concealment of strategy that takes place on a football field or in a poker game.

You just never know

Marvin Johnston KE6HTS of Santa Barbara likes hunts that include some on-foot transmitter tracking. "Most of the time, my team hides a number of Ts at a local park with notes attached," he writes (**Photo A**). "On one hunt, special rules gave any beginners a 10-minute head start. One new ham showed up at the starting point and received the early go-ahead, although nobody thought it would help him.

"Out at the park were three transmitters," KE6HTS continues. "Most people found the first with no problem. The second didn't prove to be too difficult, but almost everyone had trouble finding that last one.

"Our beginner found his way to the park and soon he had a slip for one T. Everyone noticed that the third T seemed to be changing directions. Our beginner got tired and sat down to rest for a bit. One of the other hunters got a strong signal near him and asked if he was sitting on the T. He jumped up and started searching again, but no luck.

"One hunter had a field strength meter and our beginner got a chance to see how effective it was in getting bearings. He commented that the signal was really pretty strong so it must be nearby. After another five or 10 minutes passed, everyone finally figured out that our beginner was a ruse. He was *wearing* the hidden T!"

It's horizontal, and it's upstairs!

When T-hunting first surged to popularity as a club activity more than four decades ago, a hidden transmitter had to be inside a rather large object to be truly hidden. The tube-laden rigs of that era generated lots of heat and needed lots of battery power. Today a hidden transmitter can go almost anywhere, as was proven by Steve Harris KD6LAJ on a Sunday afternoon hunt in the San Gabriel Valley of southern California. Steve built a tiny two-milliwatt device to fit inside a bikini top.

"It is just a little oscillator that I originally designed to run on nine volts," Steve says. "The batteries are on one side and the oscillator on the other. I ran fine wires in the string strap from cup to cup for power, and around the back for the antenna. This gives the signal horizontal polarization. The negative power lead serves as the counterpoise."

"The nine-volt battery was too big and uncomfortable so I redesigned it to use two AAA cells," Steve continues. "The battery holder is carved out of practically nothing. It and the oscillator are embedded in some 3/16-inch foam and there is another layer of thin foam on the outside, so the circuitry can't be seen."

KD6LAJ asked Tonya Beverly, a friend of one of his friends, to wear the bikini-T so that none of the hunters would recognize her. Tonya turned out to be quite an actress. "I had her sit on a blanket in a park with her book, just studying and sunbathing," he recalls. "Actually, she did have a final exam the next day. I figured hunters might be reluctant to go up and talk to her, so I encouraged her to speak to them."

The Tonya-T was actually the second transmitter in that day's event. The first was transmitting continuously on another frequency to get the hunters and their vehicles from the starting point to the park, which is on a dead end street in the city of Glendora.

"The first hunter to the park was Rick Barrett KE6DKS," says KD6LAJ. "He found the first transmitter with its sign-in sheet, announcing the second transmitter frequency. As he began to get bearings on it, Tonya walked over to him and asked what he was doing, pranced around him and confused him really well. After all, it's hard to get bearings when the T is moving around you!

"She then walked back to her blanket. Being a gentleman, Rick walked over to me and asked, 'I have only one question, how come the T follows her around?' I decided that was good enough and told him what was going on.

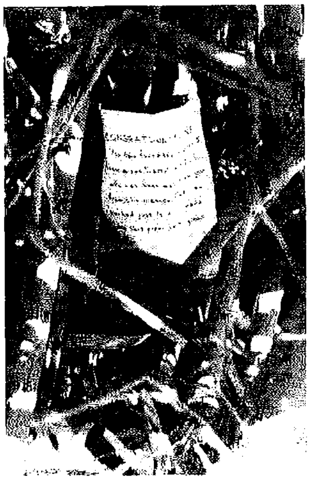


***Photo A.** If you don't want hiders to get carried away and dig up your buried or well-camouflaged transmitter, attach a note with instructions so that they find (and read) your note first.*

"The next hunters were Milt Ronney WA6FAT and his son Martin WB6YMI. When she went over to them, they were totally distracted. Martin got to talking with her so much that I don't think he ever figured it out. Then Don Lewis KF6GQ and Scot Barth KA6UDZ came into the park. I had told Don to expect a unique hunt, so he brought his video camera. Scot found the high-power transmitter first and soon had a pretty good idea where the second one was.

"Don started a bit later because he was taking video, but eventually his equipment led him to believe that Tonya was sitting on the RF source. He told her to get up, then he grabbed her papers and blanket and threw them in the air (**Photo B**). Not finding the transmitter, he asked if it was in her shorts. 'Look,' she told him indignantly, 'there's no T in my pants!' Scot immediately replied, 'Check the signal again. It's horizontal, and it's upstairs!'"

Flyaway fox

One of the most elaborate deceptions I've heard in a long time was by Greg Miller KJ7GJ

---

into something. For the pure pleasure of sharing a great hobby with children in the relaxed, carefree atmosphere of a camp, you can't beat ham radio as an activity. It also offered a good alternative to those kids who were not especially athletically inclined.

For those of us who are dedicated to working with young people and helping them to become the best they can be, I suggest you get involved with a school or a camp, and help to introduce them to the wonderful world of amateur radio.

of the Boeing Employees Amateur Radio Operators North Society (BEARONS) in June of this year. This club has a set of basic hunt rules, but allows the hider to set specific conditions for his or her hunt.

Greg announced an eight-page area in the bound Seattle area map book as the boundaries for the hunt. He chose a meeting point for the hunters at a restaurant just outside the boundaries. He told them that if they didn't all hear him at the start to coordinate with one another to get an initial bearing.

Greg advised that this would be a "semi-mobile" hunt. The fox would be stationary for the first 30 minutes, then move to another spot while still transmitting regularly. It would stay at the second spot for 30 minutes, then move again, and so on, for a total of three moves. Each move would take no more than twenty minutes.

To win this hunt, a team had to be first to find the fox vehicle. Greg promised to respond if they waved, flashed lights or honked the horn at him. "What these intrepid souls didn't know," says Greg, "was that I was going to be airborne with my friend in his Cessna Cardinal. The stopping points were to be local airports on the selected map pages.

"I had called Charles Scharlau NZØI, the local hunt organizer, to talk about the rules I would use," Greg continues. "I always used the word 'vehicle.' Charles didn't even notice it and assumed I was talking about my little red Sundance.

"At the start, we were on the ground at Paine Field, five miles north of the starting point. I could hear some people over around 128th Street in Everett talking about picking up the signal. We remained there at Regal Air for a half hour. The hunters were closing in, but we got airborne before anyone could see us.

"Without telling that we were moving, we headed east about half way across the hunt boundary with the intent of going to Monroe. The weather minimums were below standard for landing there, so we turned north, then turned around and circled my house to give them something semi-stationary. We went around about seven times and then lined up at Monroe again. There was still a heavy crosswind and rain. We started the descent, but the pilot quickly decided it would be best to execute a missed approach and go to Harvey Field to land. That airport is at Snohomish, about nine miles northeast of the starting point.

"We had no sooner touched down at Snohomish and were rolling the plane under cover when Jim Bowman W7HPK and his wife Betty drove in. About the time we were getting into the pattern at Harvey, they had been coming across the valley and headed to Monroe. We came in across that road and they saw the signal strength come up. We entered the pattern, which caused signal to go up again. They were driving off the end of the field when we landed and the signal went up and down for the third time.

"They checked all the parking lots in the area, including a restaurant and baseball diamond. Just as we were finishing pushing in the plane, they saw me. Shortly thereafter, Charles and his wife Karen N7SRO showed up. Charles identified the transmitter, which was sitting on the tail of the airplane. Then he remained transfixed, staring at the airplane in a mixture of consternation and disbelief.

"Rich Wilson N7WWU and Tom Bruhns K7ITM showed up and, after spotting some familiar cars in the parking lot, parked and hunted with their sniffing gear for quite a while. I repeatedly told them that the transmitter was in 'plane sight.' Finally Rich walked out among the hangars and found the transmitter.

"Most of the hunters' initial inclinations were to do me bodily harm, but they all showed admirable restraint. We gathered at a restaurant and discussed the hunt over lunch. Interestingly enough, Jim and Betty were able to tell almost exactly where we had flown, having gotten accurate bearings all along. The only reason that they didn't catch me is that they weren't looking up. Strangely, no one seemed to want me to be the fox again any time soon."

Doppler-to-APRS update

Back in August 1995, "Homing In" described a simple interface unit that ties Doppler RDF sets into the Automatic Packet Reporting System (APRS) program by converting the Doppler's LED direction indications to a RS232 data stream. Robert Swain KA4JSR, then N7LUE, developed the interface and sold kits for it. Judging by my mail, the project is still popular, but Robert has stopped selling kits due to lack of available time.

Fortunately, KA4JSR has put his circuit into the public domain. A supplier of bare boards has been found, so you can still build the project at home. All of the details are at the "Homing In" site on the World Wide Web. The URL is at the beginning of this article. At least one of the ICs has become scarce, so check the latest project status at the "Homing In" site before ordering.

The Swain interface works with almost every LED-readout Doppler set in the amateur radio market, including all versions of the Roanoke Doppler. However, it is not intended for use with the Agrelo DFjr™, which has its own proprietary RS232 and APRS interface provisions. 73

Photo B. "OK, I'll get up!" Scot Barth KA6UDZ (left) and Don Lewis KF6GQ (right) think Tonya is sitting on the hidden transmitter (photo by Steve Harris KD6LAJ).

Number 77 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

Field Day without OSCAR 13 or Phase 3D

When the orbit of AMSAT-OSCAR-13 finally decayed late last year, many had hoped that Phase 3D would soon be launched to take its place. P3D was scheduled for a ride to space on the second flight of an *Ariane 5* rocket from French Guiana. The first flight of an *Ariane 5* ended in disaster on June 4, 1996.

The *Ariane 501* rocket performed perfectly, but the software failed in the inertial guidance system. The *Ariane 5* has two guidance system computers and both had malfunctioned. Code for an *Ariane 4* rocket had been inadvertently loaded into the system. Differences between the two rockets are significant.

Soon after liftoff the guidance system had been commanded to turn too quickly. The rocket veered out of control and self-destructed only 30 seconds after ignition. Not much was learned about the flight

Continued

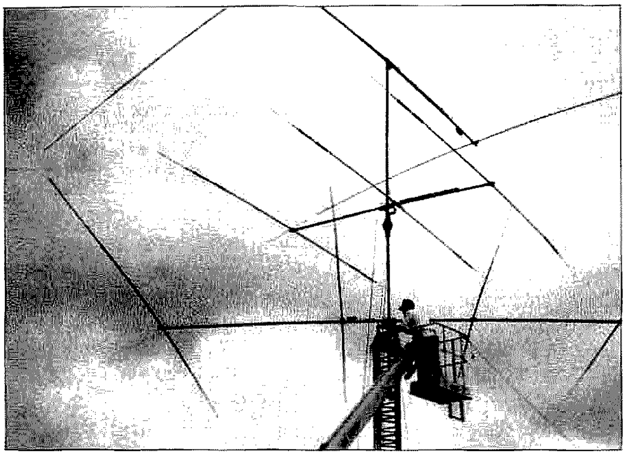


Photo A. *Serious HF antennas at the K5DX Field Day station needed some minor repairs as the competition began.*

characteristics of the first *Ariane 5* in those 30 seconds, but some data concerning vibration and other launch stresses was gleaned from the telemetry.

When AMSAT (Radio Amateur Satellite Corporation) was notified by ESA, the European Space Agency, that P3D would be subject to stresses on the *Ariane 502* flight beyond the current design parameters, a study was initiated to identify any deficiencies in the satellite and correct them before launch. These efforts have been a focal point of work on the satellite and have caused delays with other key components in P3D construction.

AMSAT technicians, engineers and volunteers worked diligently during August to finish structural enhancements to the spacecraft. Teams from Germany, Belgium, Slovenia, Hungary, Japan and the Czech Republic descended on Orlando (Florida) to join the effort to ready the P3D transmitters, receivers, momentum wheels and computer modules. If there are no further slips in the ESA schedule to launch *Ariane 502*, and the round-the-clock efforts to finish the mechanical upgrades and component integration are not completed in time, P3D may have to schedule a different ride to orbit.

During its lifetime, A-O-13 was available for eight Field Days from 1989 through 1996. With beam antennas and 25 to 100 watts on 70 cm, many excellent contacts were possible for any Field Day group that wanted them. A few years had marginal orbits over the US during the fourth weekend of June, but some access was always possible during the 24-hour contest period.

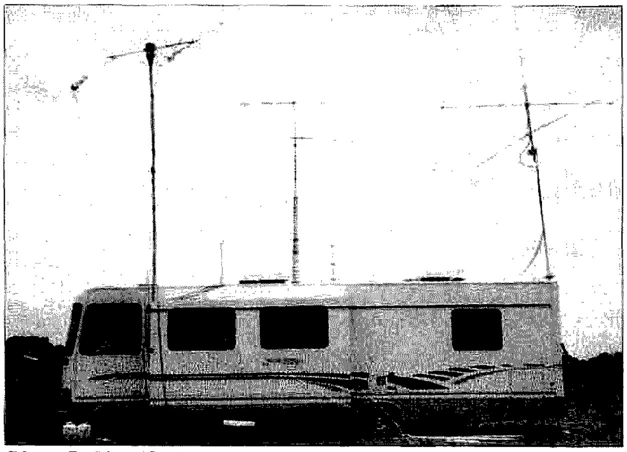


Photo B. *The K5DX satellite Field Day operators enjoyed the luxury of a new motorhome for the 1997 event. Air conditioning, TV and microwave ovens certainly help.*

P3D promises the same quality contacts, but with some significant improvements. The key differences between A-O-13 and P3D are the number of transponders and the ground station requirements.

During its last years, A-O-13 supported two transponder modes, B and S. Both had 70 cm uplinks, but Mode B had a two-meter downlink while Mode S had its output in the 13 cm band. P3D sports a matrix of uplink and downlink possibilities ranging from a receiver on 21 MHz to a transmitter on 24 GHz. The individual receivers and transmitters can be paired up by ground control stations in any possible combination as long as a frequency conflict does not occur.

Due to the height of the apogee or high point of A-O-13's orbit, signals from the satellite's transmitter were relatively weak on Earth compared to other hamsats. While the low-orbit satellites are usually only 600 to 1000 miles up, A-O-13 ranged out beyond 20,000 miles. P3D will use a mix of gain antennas and power amplifiers to overcome the distance factor from a similar orbit. P3D ground stations will require smaller antennas for the same results they had through A-O-13. On Field Days of the future, it may be possible to use simple omnidirectional antennas and still make solid contacts. Small dish antennas should be acceptable for the microwave bands. The digital transponders on P3D will add other possibilities not yet considered.

For Field Day 1997, though, neither A-O-13 or its replacement, P3D, were on hand to carry the contest. Enthusiasts were forced to check the other hamsats. The results were surprising.

A-O-10 vs. Fuji

During Field Day many expected AMSAT-OSCAR-10 to carry a large percentage of voice and CW activity even though it has been virtually uncontrollable since 1986. When the solar panels are sufficiently illuminated, A-O-10 can provide excellent communications.

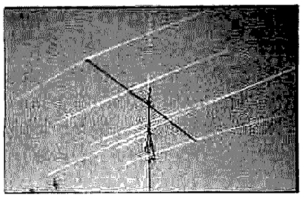


Photo C. *K5DX had two satellite arrays. This one had an omni antenna for two meters, a four-element yagi for 10 meters and a dipole for 15 meters.*

During the contest, A-O-10 was working quite well but signals from the satellite, when at apogee, were weak for most portable stations. Field Day participants were forced to find other transponders for their efforts. The low-Earth-orbit (LEO) satellites took over. Fuji-OSCAR-20 logged the highest percentage of Field Day contacts with RS-15 and Fuji-OSCAR-29 running just behind A-O-10. The relatively high orbit of F-O-20 allows longer access times and greater distances than most LEO hamsats. RS-15 also has a high orbit for a LEO, but the relatively weak downlink on 10 meters encourages the use of beam antennas and RF-quiet locations. RS-12 and AMRAD-OSCAR-27 provided additional opportunities for satellite contacts although the single-channel FM transponder on A-O-27 sounded more like a giant pileup on an FM repeater. On the analog side, Field Day via satellite was a lot of fun.

For those who were equipped for digital operation, the 9600-baud satellites provided many points in the AMSAT Field Day competition. The American Radio Relay League Field Day does not recognize uploads and downloads via the digisats, but AMSAT does. Each Field Day greeting upload addressed to ALL (one per satellite) and all the Field Day greeting downloads sent by other stations count for three points each. Although it is possible to get a respectable score just by working the analog satellites, to get first place in the AMSAT activity requires a presence on the digital systems. Due to the nature of the AMSAT rules, it is even possible to get points without transmitting. Many short messages (like Field

Photo D. Mike WA5TWT works a Fuji-OSCAR-20 pass at the K5DX Field Day satellite station.

Day greeting messages) can be received from the digital satellites simply by monitoring the downlink and collecting all the traffic that the satellite transmits. Although no SWLs (short wave listeners) submitted entries this year, it is certainly a possibility in the future.

Kitsat-OSCAR-23 logged the most messages due to its high orbit and excellent signal, while Kitsat-OSCAR-25 and UoSAT-OSCAR-22 certainly added to the totals. Some stations also used the 1200-baud systems on AMSAT-OSCAR-16 and Lusat-OSCAR-19. The 9600-baud hamsats were clearly the front runners, but the others provided extra points.

John Stephensen KD6OZH had the highest verified score in the AMSAT contest from his home in Los Angeles, California, using emergency power. John operated through A-O-10, F-O-20, F-O-29, RS-15, A-O-16, L-O-19, U-O-22, K-O-23 and K-O-25. The Sussex County Amateur Radio Club came in a close second with verified contacts and digital activity from their portable location in New Jersey using the callsign N2WM. They skipped the 1200-baud satellites, but added analog operation through RS-12 and A-O-27. Many others participated in the competition, including DX stations in Europe, Africa and Central America. As can be seen by the list of hamsats available for the event, there are many exceptional communications resources available even without A-O-13. 73

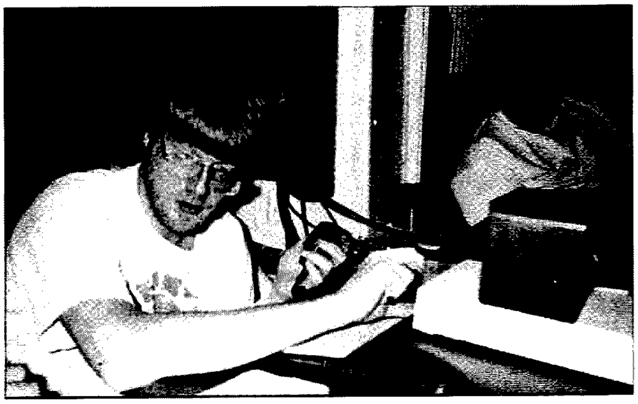


Photo E. Marty WD5DZC checks out an early morning AMSAT-OSCAR-10 pass while Charlie N5XGW listens at the K5DX Field Day 1997 satellite station.

NEVER SAY DIE

Continued from page 70

Rock'n'roll, rap, and so on produce stunted plants. Classical music spurs growth. Just as with kids.

Water, in some way, is able to store magnetic energy too. If you want really powerful water, first distill it so you're rid of the fluorides and chlorine in our tap water, then put the water in a glass bottle in the sun with the south pole of a strong magnet under the bottle. If you can find some quartz glass bottles, they'll do even better. Use this water for your plants, and for your own drinking too. Remember, your body needs about eight glasses of water a day to function best.

The north pole has its uses too. For instance, animal research on cancers showed that a magnet could stop the growth of cancer. This research was done over 20 years ago, but as far as I've been able to find there isn't any hint that the National Cancer Institute has made any effort at all to follow up on this work. Well, the treatment isn't patentable, so there's no commercial interest in developing it. A low-cost cancer cure would lose the medical industry hundreds of billions of dollars in revenues and put thousands of cancer researchers out of work.

If you think I'm crazy on this, then at least do me the courtesy of doing your homework. I've done mine. And then get some strong magnets and see for yourself what north and south poles can do for your plants, for you, and your children.

The Rawles and Davis book also lists a bunch of illnesses that can be helped with magnets, using the north pole to slow or stop unwanted functions and the south pole to improve circulation and energize organs. Which may explain why my visiting friend is convinced that magnets can help or cure almost any illness. Now, if I can just get him to start writing some articles on the subject!

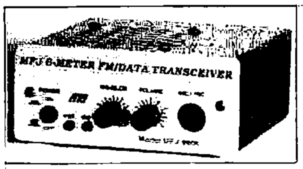
Forgetting Things?

Talk about getting too late smart! Several years ago I heard Dr. Hal Huggins (a dentist) giving

Continued on page 83

Number 80 on your Feedback card

NEW PRODUCTS



Join the Fun on the Magic Band!

MFJ's new MFJ-9606 *FM Communicator*™ is a perfect 6 m transceiver for No-Code Techs and veterans alike—use it for packet, data or voice. Packet-ready and compatible with virtually any TNC, the MFJ-9606 is the perfect way to stay in touch with your club members, especially with the growing number of 6 m repeaters.

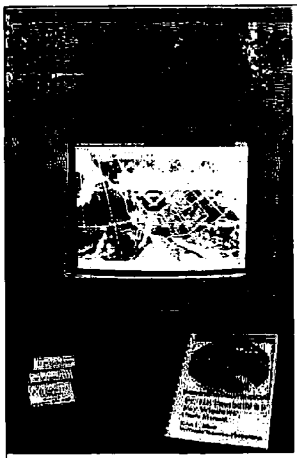
The 10-watt transmitter has plenty of power to enjoy FM simplex, repeater or packet service, and if you need more power out, it's fully compatible with MIRAGE's high-power 150 W A-1015-G amplifier.

MFJ-9606 features MFJ's exclusive *CrystalClearVoice*™ that gives true-to-life speech quality and ultra-clean AFSK data signals. An optional plug-in CTCSS encoding module is available soon for accessing protected repeaters. Superfast PIN diode transmit/receive switching keeps turnaround time real low—perfect for packet and other data modes.

The MFJ-9606 can be run 24 hours a day without even getting warm, drawing less than 30 mA. It gives you a super dual-conversion FM receiver with quiet LNA front end, the same LNA used in the popular 6 meter SSB MFJ-9406 transceiver—exceptionally pleasant because of its clear audio reproduction, loud built-in speaker, and choice of squelch modes.

Choose your squelch! Select conventional hysteresis squelch for weak signal base-to-mobile service, use MFJ's exclusive *Instant-OnSquelch*™ for tail-free repeater or packet operation, or use open squelch if your TNC has a noise rejecting DCD.

Built to last and designed for simple operation, the MFJ-9606 is only $149.95, and of course it's covered by MFJ's famous *No Matter What*™ one-year unconditional warranty. For your nearest dealer or to order, call (800) 647-1800; FAX (601) 323-6551; or write to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.



Wefax for Windows™

SSC is proud to announce the release of PC HF Facsimile 8.0 for Windows. PC HF Facsimile 8.0 allows users of Windows PCs to receive wefax charts, weather satellite photographs, radio teletype, NAVTEX, FEC, SITOR, ASCII and Morse code digital news and weather broadcasts. By connecting the package's demodulator between the computer's serial port and a single sideband shortwave communications receiver, digital radio transmissions can be received, displayed, printed or recorded on disk. SSC's new Windows FSK demodulator allows the program to operate in the background while the operator is performing other tasks under Windows. The package is ideal for mariners, aviators, agriculture and weather enthusiasts.

It includes image and text decoding software, a miniature demodulator, tutorial audio cassette, comprehensive manual, worldwide frequency list and broadcast schedules. System requirements are Windows 3.1x, Windows 95™ or Windows NT, 8 Mb ram memory (4 Mb under Windows 3.1x), 6 Mb hard disk space—and all for a suggested retail price of $179.95.

Collins Fans Take Note!

Hi-Res Communications has introduced three new video additions to the famous Collins Video Library! "The R-390A" features noted expert Chuck Rippel WA4HHG, and runs a full seven hours, covering topics like "Modules," "PTOs," and "Restoration." It's an amazing education in the R-390A, for only $109.95.

"The 75A-4" features Butch Schartau KØBX, who will guide you through four hours of information on how to repair, maintain and restore this classic, for $89.95.

For owners of the "Gold Dust Twins," "The KWS-1" is the perfect companion to the 75A-4 video. Butch Schartau shows you how to operate, maintain and repair your KWS-1. This two-hour video is a must for all KWS-1 owners, at $39.95.

Purchase of any three or more videos from the Collins Video Library qualifies you for a 10% package discount, and VISA and Mastercard are gladly accepted. For mail orders, add $4.50 each for the first two videos for shipping in the US. Additional videos are shipped at no extra charge. For more information, contact Hi-Res Communications, 8232 Woodview Drive, Clarkston MI 48348-4058. Phone or FAX (248) 391-6660; E-mail: [hires@rust.net]. Check out the Web site at [http://www.rust.net/~hires].

Mouser Unveils New Web Site

Mouser Electronics, one of the 50 largest electronic component distributors in the US, recently updated their Web site. New features include a user-friendly interface, product pricing, product availability, and excellent search engines, allowing searches by part number, manufacturer's name, product type, keyword, or catalog page. There are also links to Mouser's manufacturers' Web sites. Catalog pages are viewable with Adobe Acrobat Reader 3.0™, which can be downloaded from their Web site.

The complete Mouser catalog can also be downloaded—it takes a while but it's worth it; it's well done and text searchable. On the Web site you'll find a subscription form for the CD catalog, and both the downloadable catalog and the CD-ROM catalog are PC and Mac compatible. The paper version of the catalog can be ordered on-line, too. Check it all out at [http//:www.mouser.com].

Every CyberHam Needs One

Does your mousepad have your callsign on it? No? Like, you're *so* ten minutes ago! Ask your teenager what that means—and then get the latest catalog from Old West Graphics. They have a whole line of graphic mousepads, in categories such as Cowboys, Skywarn, Trucks, etc. When hams order personal mousepads, they choose from the available designs and Old West Graphics will add callsign and city/state to the design—for only $16.95 plus $1.50 s&h. Club event coming up? Old West Graphics also manufactures banners, ARC logo decals, magnetic signs, and other stuff so you can let the world know about your hobby!

Write to the nice folks at 490 N. St. Louis Ave., Loveland CO 80537-5878 or call (800) 484-9492 ext. 8601. To FAX, press 0 at the prompt.

Communications Simplified, Part 23

The series concludes.

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

As I mentioned when I started this series almost two years ago, these "Communications Simplified" articles are a sort of work-in-progress—they are class notes for a community college communications course. They will eventually become a textbook; in the meantime, I thought hams and readers of *73 Magazine* might be interested in them, too.

But that college course has changed in the past two years. All of my current communications students are telephone company employees, and so I've had to go off in somewhat different directions. You may have noticed that as we discussed modems and ISDN lines last month. From this point on, my course will become even more telephone company-specific.

Unfortunately, this is going to bring us further and further away from ham radio, so I've decided to end this *73 Magazine* series before I bore all you readers to death.

Let me, therefore, end with an absolutely true story. I vouch for the fact that it really happened about ten years ago.

One of the older lab experiments in our course has been to give our students a defective AM radio, and ask them to troubleshoot and repair it. These troubles are usually fairly simple, but it still takes most students an hour or two to find the problem.

This one term, though, one of the groups called me over within five or 10 minutes: "Professor Stark, Professor Stark, come here, come here, we fixed it!"

I went over to see.

Their radio was still connected to a bunch of test equipment, and all I heard out of the speaker was a loud beeping tone.

This particular group consisted of some of the weaker students in the class, so I was sure they couldn't possibly have found the problem so quickly. I was convinced the tone was caused by the signal generator that was still connected to the radio, so I started looking for something to prove them wrong.

I was just about to make some snide comment, when the tone stopped and the radio said "This was a test. If this had been a real emergency ... "

P.S. I was right. Their radio had a bad oscillator, but they had accidentally connected their lab signal generator to a point where it would provide a substitute signal. Then they noticed that, as they tuned the signal generator, they heard some stations. So they just tuned in a local news station, and called me over.

Well, I hope you had as much fun learning from this series as I had presenting it.

Here's to simplicity!

Remembering Ivan's "Woodpecker"

Or was it?

A.N. Onymous

I had a dream last night about the woodpeckers of yesteryear, and I awoke very troubled—as one does in the aftermath of a nightmare ...

It was a beautiful Sunday morning back in the early '70s and I was chatting with an old friend on the low end of 40. A woodpecker ended it all. Pinned the S-meter 40 over nine, and wiped us out. Finally, the pecker quit. We were both upset and signed clear.

I leaned back in my chair to consider this plague on shortwave radio. Finally, reason prevailed and I said to myself, "No damned over-the-horizon radar station in Russia could possibly be that strong here in Oregon on 40 meters at 11:00 in the morning because the skip is wrong. Even Rollie, a few blocks up the street, wasn't much stronger and he was line of sight ... Line of sight? Up? Satellite? Possible!"

A few minutes later, I had my old surplus scope going, and was looking at the audio output from my old National to see what this plague was. Shortly, I had some answers. First off, it wasn't just one pecker—there could be several of them individually controlled, or group controlled. That was why the tone of the pulse seemed to shift at times. They all worked exactly at the same repetition rate, but with different start times. Further, when I set the scope delay and looked at the top of the pulse with the delayed, expanded sweep of my old scope, I was startled to see video riding on top of the pecker. As a TV ex-chief engineer, I very well knew what a single line of video looked like.

I was an assistant professor at a local community college, so I gathered myself up and spent the rest of my Sunday in the lab unscrambling peckers. At that time we had quite a bit of good surplus equipment, including several 535s, an excellent Tek timebase, and a good, magnetically-deflected 14-inch monitor with P7 phosphor.

We had an old all-band receiver with only one stage of 456 IF which was fairly broad. Not the best, but OK for a pecker picker-upper. It didn't take long to figure out that a horizontal line for the monitor would be the pecker pulsewidth, and the vertical scanning was formed by the motion of the satellite as it traveled at about 17,500 mph over the area being observed. The satellite pulse rep rate was extremely accurate at 10 pulses per second. In order to get a reasonably stable raster on the monitor from a pecker, I had to use our Tek timebase, which had a temperature-controlled crystal oscillator and divide-down multivibrators.

I used two old Tek 535 scopes for the horizontal system. The first scope was synced to the Tek timebase. Its CRT was used to select a pecker from the group for observation and to provide a delayed trigger to enable the second scope, which showed a line of video per pulse. The second scope had output terminals for the truncated sawtooth it used to sweep the CRT. This became the horizontal sweep for the monitor. The vertical scan came from a third Tek scope running free, quite slowly, with its external sawtooth fed to the monitor and set to make a symmetrical presentation on the P7 screen.

Most of the pictures we looked at were clouds, but we had enough detail to see pattern breaks—occasionally. We didn't try to correlate our monitor screen with a known landform, as it wasn't our purpose. But it was quite evident what the pecker represented. On the following Monday, I showed the setup to some fellow instructors who were ham friends and explained it to some advanced students. Then I dismantled it and put the components away. I had answered all the questions but one.

That summer was hamfest time in our area, and of course I attended. Things started to slow down. I went to the person in charge of program presentations and said I could explain what the Russian Woodpeckers were and he said 4 p.m. in the meeting hall. Believe me when I say the place was crowded, and they weren't all happy campers. I went to the blackboard and diagrammed what the pecker was, and the interconnection of surplus gear I had used to unscramble it. I concluded my presentation by saying that we didn't really know who was responsible for the peckers, but that it was strange that the pecker activity really picked up at the start of the war between Afghanistan and Russia.

And why would Russia use satellites when they could use airplanes? Then I added that if indeed the peckers were ours, they were looking after the best interests of all of us.

The next February there was a hamfest near Salem, and I was asked to come and repeat my lecture on the Russian Woodpeckers.

I agreed to do so. When the time came, I was introduced to the crowd as the guy who figured out what the woodpecker was, and that CBS television had confirmed my findings by recently carrying a story on the late news that the United States had admitted our forces were responsible for the "Russian" woodpecker. Nothing further was ever said and soon they shut them down. A year later, the head of the FCC was still calling it the Russian Woodpecker and describing it as a Russian over-the-horizon radar. A bad rap.

Well, 25 years later there's the story, and the question is, *Who really told a story?* As for me, "Ain't nobody here but us chickens"—but I do think old Ivan could use an apology.

NEVER SAY DIE

Continued from page 79

a talk on mercury poisoning at the Tesla Society conference in Colorado Springs. Quite a few hams attend this conference every year and they even have a ham station set up in the conference lobby. Anyway, that was the first I'd heard about the mercury in dental fillings being dangerous. Hal made a very convincing presentation, complete with some videos showing the amazing recovery from multiple sclerosis of people who'd had their amalgam fillings replaced with plastic. This was of particular interest to me because one of my grandmothers died of MS, and there's always the nagging thought that it might somehow be a genetic illness.

Hal's book, *It's All in Your Head*, was very well documented and, I thought, a book everyone really ought to read, so I included it in my guide to key books.

Cut to May this year when I was on the Art Bell (W6OBB) radio talk show. In addition to our talking about amateur radio for about an hour, I mentioned that I was convinced that all illnesses had to do with either our poisoning our bodies, or giving them too little of the nutrition they have been designed to operate on. I included dental amalgam in my list of poisons and Art got all upset. His dentist, in whom he had great confidence, had assured him that amalgam fillings were perfectly safe. Art refused to accept my information.

Then, when he opened the phone lines, two dentists called in and both said I was absolutely correct, that the mercury in fillings is a deadly poison. Art was depressed over this news because he has several fillings, as most people have.

Lydia Bronte heard about this and sent me a copy of her book, *The Mercury in Your Mouth — The Truth About "Silver" Dental Fillings*. This is published by Quicksilver Press, 10 E. 87th St., NYC 10128. 1994, 189p, $15, ISBN 0-9643870-0-X. You really ought to invest in this wonderfully researched book. You won't believe the long list of illnesses which have been cured or greatly improved by removing amalgam fillings. The chapter on mercury's connection to Alzheimer's made me wish I'd done my homework in time to help save my mother from this terrible disease.

This is not a matter of opinion, for endless research has been done on both animals and humans and the fact is that the mercury in your fillings (they're about 50% mercury) leaks out into your body where, depending on your sensitivity to it and other immune system depressants, you can be heading for an Alzheimer's future, Parkinson's, antibiotic resistance, and any number of autoimmune problems.

Judging from the incredible number of hams I see at Dayton who have great big fat guts and are smoking, I realize that my preaching about health is probably, at the least, irritating. If you wanted to live much past your 40s in good health you'd have changed your living style long ago. Most people (and that, generally, includes hams) live for the pleasure of the moment and don't even want to know about the long term results of what they're doing. Otherwise they wouldn't be eating the garbage they are and dumping one poison after another into their bodies.

I've taken better care of my body than most people, so at 75 it's in pretty good shape. Oh, I've dumped a ton of doughnuts and coffee into it at ham club meetings. And tons of ice cream and soft-serve, plus more tons of pies, cakes, and cookies. Heck, I was about 100 pounds overweight until 25 years ago, when I decided to stop that nonsense. Been there, done that.

Now that I know better I've been treating my body with more respect. It gets lots of fruit and vegetables, plenty of distilled water, daily exercise, and so on. No, I don't have any fillings. I had 'em all removed years ago. But up until then I had a mouth full of 'em, and several root canals too. More poison.

Yes, I know the ADA is still saying that amalgam fillings are safe. And the cigarette makers are swearing that cigarettes are not addictive and don't kill us. Just think of the lawsuits dentists would face if the word got out about the millions of people they've killed via mercury poisoning.

Getting your fillings replaced isn't easy. The Bronte book lists dentists who will do the job, but the ADA is busy making life miserable for these renegade dentists.

Health Tompoopery

Lordy, I need an assistant just to deal with the piles of Tompoopery my mail brings almost daily. There seems to be an endless supply of "scientifically proven" nostrums, many being peddled via multi-level distribution systems. If I'll sign up as a distributor I'll get a 50% commission on what my customers buy and 20% on what their customers buy. What a great chain-letter approach to selling!

Unfortunately, the more I read by authors who make sense to me, the more I'm convinced that our whole medical industry is no more reality-based than the nostrum peddlers. If you are convinced that ingesting hexichlorodimethylbenidrine is going to alleviate the symptoms your body has been flashing as a warning signal that you're screwing up, then pop those expensive pills.

Health is simple. Robust, vibrating health is simple.

Within the limits set by your genetic makeup, and that includes any damage done by your parents to your genetic blueprint even before conception, your body is designed to operate and renew itself for around a hundred or so years. You can screw this

marvelous system up by throwing sand in the gears, sugar in the gas tank and sludge in the sump—putting poisons in your body and not providing it with the fuel it's been designed over millions of years to use. News flash: your body was not designed to function on a coffee-and-Danish breakfast.

Does that make sense?

Look, even the worst of plagues had survivors. So how were they different? Simple: They hadn't crippled their immune systems.

If you want to give your children their best chance at being healthy and intelligent, then don't do things that are known to cause birth defects—like smoking crack, drinking alcohol, smoking cigarettes, drinking coffee and so on. These all create birth defects, though many are not easily visible. And this means not just during pregnancy, but even before conception.

Your body is designed to deal with the nutrients at hand back in the prehistory days. Raw foods. Clean air. Sunlight. And a lot of exercise.

So we eat cooked food, usually laced with chemicals to keep it from spoiling on the grocery shelf (and in the distributor's warehouse), and we poison our bodies in a wide variety of ways, all of which reduce our immune systems' ability to deal with emergencies.

Poisons? Mercury from dental amalgam. Fluorides in your water supply. Chlorine, ditto. Nicotine, caffeine, alcohol, aspartame in diet drinks, immunization shots, air pollution, sunglasses to keep needed sun's rays from reaching your eyes, electromagnetic fields from electric blankets (and amplifier power supplies), radiation from TVs, and so on. You really don't want to know the horrible history of what the introduction of sugar and white flour has done to one civilization after another.

Oh, I almost forgot, our food supply is grown in fields which long ago lost their critically important (to our bodies) minerals. When they're added to the fields the results are truly amazing, but it's easier and cheaper to throw on chemical fertilizers (NPK), so that's what's happening all over the world.

Every bit of what I've said here is backed up by books reviewed in my guide to books you should read.

The bottom line is clear: when you get sick, you've done it to yourself. So you can look for a magic cure with any of the endless nostrums, or (even worse) medications from your friendly doctor. Well, that's better than changing your diet, right?

The Deficit

Old what's his name, the guy with the big ears down in Texas, made a great big deal out of the escalating deficit. I love all the creative accounting both the Republicans and the Democrats are using to make it seem as if the deficit is being reduced. A reduction in the growth of the deficit is being heralded as a reduction of the deficit.

P.J. O'Rourke, in his *Parliament of Whores* (his name for Congress), showed that the budget could be easily balanced, if Congress had the guts. Guts is not a requirement for being elected to office, just an extended hand, palm up, for money.

I love Congress' move for a balanced budget amendment. It's a please stop me from hurting our country deal. A sort of moral imperative for the totally gutless.

Well, enough of my fruitless grumbling—there's no way I'm ever going to convince you to stop re-electing professional politicians and flush that stinky Washington toilet. So let's contemplate the deficit.

A big part of the budget every year is the interest on the accrued deficit, which has been heading up towards equaling the country's annual revenues. And that doesn't even count the trillions of off-budget liabilities and expenses. Interest payable to whom? The government bond holders, which are mainly foreigners and the banks that make up the Fed.

So these banks lend our government the money for Congress to spend. And where do they get the money to lend our government? Well, they're "good for it." Cozy arrangement, and one that's been going on for a long time. It's probably better that I don't write much about all this, else I could find myself disappeared.

Olio

For those of you who are not crossword puzzle addicts, olio means a collection of something. Yes, I admit to being a crossword puzzle addict. It's the first thing I reach for when I get on a plane. Most of the airline magazines have one toward the back. And I subscribe to *New York* magazine for their puzzles.

Our Unconstitutional Congress

A recent piece by Stephen Moore of Cato Institute in *Imprimis*, which you probably missed, discussed the breaking of the Constitution by Congress, with the connivance of the Supremes.

In 1800, when the capital was moved from Philadelphia to Washington, all of the government's paperwork was packed into twelve boxes and moved by horse and buggy. At that time our government had less than 3,000 people and a budget of under $1 million. That's about $100 million in today's dollarettes. Now we have over 18 million employed and a budget of $1,600,000 million.

What happened?

The US Constitution was established as a set of rules for our government, with its responsibilities restricted to its enumerated powers, which mainly involved national security and public safety. You will not find any authorization in the Constitution for at least 90% of the civilian programs that Congress has in the federal budget.

The founders, well aware of the propensity of governments to bloat, tried to prevent this by making the Constitution very specific on this matter. The Tenth Amendment says, "The powers not delegated to the United States by the Constitution ... are reserved to the States respectively, or to the people." There was nothing in there about subsidizing the poor, the power companies, farmers, maple syrup production and advertising commercial names in Europe and Japan.

For over a hundred years presidents vetoed every effort by Congress to spend money on public charities, citing the Constitution. Then two things happened (went wrong!). The first was the 16th Amendment, the enactment of the Federal Income Tax in 1913. This cash cow was just too much for Congress to resist. This brought about the perversion of Article I, Section 8 of the Constitution, which says, "The Congress shall have the power to lay and collect taxes, duties, imposts, and excises to pay the debts, provide for the common defense, and promote the general welfare of the United States."

Jefferson explained that "the general welfare" clause had only to do with those powers specifically enumerated by the Constitution.

The flood gates really opened with Roosevelt's New Deal. The pork barrel was finally wide open, with the Supreme Court in 1936 providing the coup de grâce by ruling that the Agricultural Adjustment Act was constitutional. The New Deal Court essentially told Congress that it didn't matter what the Constitution said, spend whatever you please. And they sure have!

Just before World War I the total federal expenses ran about 2% of the GDP and the top income tax was 7%. But it was during World War II when it really hit the fan, with the introduction of rent control and withholding taxes. The government took our tax money before we even had a chance to see or feel it, and wow, has Congress had fun at our expense! They take away dollars and give back a few pennies, and we gratefully re-elect our benefactors. Why does this remind me of the bull ring, with the matador waving a red flag at the bull to keep his attention while he maneuvers him anywhere he wants to?

Can we ever get back to using the Constitution as a set of rules for running our country as the founders intended? Lordy, that would put maybe 15 million government employees out of work! It might even get the government out of screwing up our school, health, legal, prison, and other failed systems.

An AIDS Vaccine

President Clinton has called for the drug companies to get an AIDS vaccine to market within 10 years. The government is already spending $150 million annually on an AIDS vaccine research, so there is a huge vested interest in not making any waves.

I see two minor problems. First, there is no evidence that most vaccines actually solve problems. This appears to be another big medical scam, which you'll understand when you read a couple of the very well researched books I've recommended in my editorials. Second, drug companies, with the cooperation of the FDA, make sure that only patentable drugs are authorized for the treatment of illnesses. Thus any inexpensive, non-patentable treatment will be not just ignored, but will be fought vigorously by both the medical establishment and the FDA.

Third (a bonus), AIDS now seems to be more of a lifestyle problem than a specific

disease, one which can be reversed by stopping the destructive lifestyle. This means one has to stop poisoning one's body and give it the nutrients it has been designed to need. Thus there is no hint that there can ever be a vaccine developed for AIDS.

In the meanwhile there are all sorts of potential problems for public mischief. In a panic we rushed polio vaccines into our kids in the 1950s. Well, it now appears that, gee, there was some contamination with Simian Virus 40 which is strongly suspected to be causing brain, bone and lung cancers in adults and children.

My thanks to Frank Kavenik WA9QJR for sending me this item.

More Medical Mischief

You probably don't read *Penthouse*, and you probably also missed the publisher's interview with Art Bell, where he went into detail about his wife's brush with death by cancer. The story is in the September issue, and it's a horror story about the National Cancer Institute, the FDA, the AMA, two leading cancer-specializing hospitals, and his success using hydrazine sulfate, despite every effort of the hospitals and government to prevent its use.

The fact is that radiation and chemotherapy not only don't work, they often are more the cause of death than the cancer they are supposed to fight—at humongous expense. Hydrazine sulfate costs about $150 a year, and is unpatentable.

You can get the full facts on this if you missed getting the magazine by writing to *Penthouse*, 277 Park Avenue, NYC, and put "Cancer" on the envelope.

Budget Baloney

Not to worry you about something over which you have little (read: no) control, but I'd just like to note that unless the world does come to an end in 1998, 2000, 2005, or 2012, as threatened by some doomsayers, the Democrats and the Republicans will have again sold us down the river with the recent so-called balanced-budget agreement. Some balance.

Our party leaders took advantage of our unusually bullish economy to distribute a bunch of very questionable handouts to make themselves look good. The suckers are the future taxpayers who will have to deal with the mess.

Where did the money come from? Well, the Congressional Budget Office a year ago forecast a budget deficit of $170 billion. Now it looks as if it's going to only be $40 billion, giving the Democrats and Republicans $100 billion or so to play with. Whoopie, let's have a party! The President asked for $16 billion to fund health care for poor children and they gave him $24 billion. Then came a raft of special interest tax breaks. Like around $150 for middle-income families, $15,000 for the richest one percent of families, and more like $2 million for the likes of Michael Eisner. Figures. I'm chuckling because it was the tax increases on the wealthy in 1990 and 1993 which made this possible.

Experts agree that in about three years the deficit will not just reappear, but will skyrocket as the baby boomers start reaching retirement age. This will reduce the number of taxpayers and escalate spending on Social Security, Medicare, and Medicaid.

A Head of My Time

Hy Chantz W2HY was kind enough to send a clipping of a new product by Rossignol, the ski company, which is one I've suggested in my editorials. They've announced in-line skates which snap onto what looks like high end sneakers. Well, I've been thinking of learning to use roller blades anyway, so this will probably push me over the edge. Their Traffic skates are $150, which isn't much more than a good pair of well-advertised sneakers these days. Let's see, where did I put those knee and elbow pads, and head protector?

Not that I'll have a lot of opportunity to use 'em, since I live on a dirt road which turns to mud in the spring, a dust-clouded corduroy in the summer, and an Olympic-quality sled course in the winter.

Another Excuse

The *Journal of the American Medical Association* published a report saying that boys born to mothers who smoke during pregnancy have been found to be much more likely to exhibit aggressive, destructive or

other problem behaviors. Nicotine, they explain, tends to disrupt fetal brain development—an invisible birth defect.

Maybe that helps explain the bad language and intentional QRM on our bands.

It also raises the question, since researchers have been able to tie certain brain changes to prenatal nicotine in the mother's blood, as to what other changes it may cause—physical and genetic changes which are irreparable.

They've found similar influences from the prenatal use of alcohol, crack, and other drugs, with thalidomide being an outstanding example, so I'll be really surprised if many drugs used by mothers during pregnancy don't also do permanent damage to children. Like caffeine, aspirin, sleeping pills, and just about any other medication. Of course, if you really don't care how your kid turns out, then what's to worry? This could help to explain the growing percentage of children being born with obvious birth defects.

Space Radiation

A letter from a *73* reader who'd read René's NASA book had just one question. How come, if the effects of radiation in space are so lethal, the Russians aboard *Mir* have managed to survive? Hey, that's easy. *Mir* and all of our recent space exploration has been well below the Van Allen Belt, which shields them and Earth from the sun's killer radiation.

Speaking (well, writing) of *Mir* and the planned American spacc lab, has anyone been asking what the justification is for spending so many billions of dollars? *Mir* has been up there for years and what scientific benefits have the Russians reaped as a result? What scientific breakthroughs have been achieved from our own space experiments? Enlighten me, please. Other than as scientist and engineer welfare, what's the benefit to all of us in spending all that money?

Worse, by providing highly-paid jobs working for NASA and their contractors, our beloved government is keeping thousands of scientists from being available for private industry, where the long-range benefits would, I expect, be far greater for our country.

Japan, which has *not* spent billions on military and space projects has used its technical manpower to bury us with innovative high-tech products. Scientists and engineers in Japan go to work for Sony, Hitachi, Toshiba and so on. Ours are almost all sucked into NASA and military R&D.

The Bright Side

As shortwave broadcast stations move to the Web, we'll see 40 m opening up again for us. And we'll see not just less pressure from other services for our HF bands, we'll eventually be in a position to ask to have our bands expanded. We may go back to 7.0-8.0 MHz for 40 m, and 14.0 to 14.4 for 20 m. Or even up to 15 MHz, since commercial and government use of the HF bands will have long been moved to satellite relaying systems, which have wider bandwidths and 100% reliability.

One thing will be for sure, the CW-forever guys will be pounding away at 15-20 wpm while the rest of the world is sending audio and video anywhere in the world. Heck, I'm seeing data rates of 2,048 Kbps already in use. And we think 9.6 Kbps is fast!

Being a geriatric case, I can remember way back when amateurs pioneered new modes and higher-speed communications. Now, with the vigorous support of the ARRL, we're fighting hard to maintain the oldest and slowest radio communications system ever devised.

Yes, I agree, CW is fun. And so is making Daguerreotype photos. And running Stanley Steamers or Model Ts.

Industry Blindness

Recent brochures from power company conferences contain no hint of the coming cold fusion revolution. Well, I saw the same thing happen to the computer mainframe companies when the minicomputers came along. And then again when microcomputers (personal computers) arrived. The major computer conferences put personal computers down in the basement, or in an outbuilding somewhere. But that was only after a hard battle to even get a foot in the door.

The biggest computer conference of all, the National Computer Conference (NCC), got blown away for just this reason.

Even a 1998 conference on Renewable Energy Technologies is covering only solar, biomass, photovoltaic, small hydro, and wind power technologies—few of which are going to even be *around* in 20 years.

Elemental Energy

I've changed the name of my *Cold Fusion* journal to *Elemental Energy* for two reasons. First, it better expresses the physics of this new energy source, and second, cold fusion has had such a bad rap from the establishment that it's easier to change the name than fight emotional prejudice. The excess heat being generated by the cold fusion process is the result of the transmutation of elements. You see, when some elements are transmuted into others, there is a very tiny bit of mass lost in the transfer. But by the time you multiply this times Einstein's c^2 you have a serious bunch of energy generated as heat. That's the speed of light, squared.

Faster! Faster!

We could speed up data transmission by about three times if we encoded our words differently. Right now our computers encode every letter of every word, plus the space between words. With an average word length of five letters, plus the space, that's six characters we send for each word.

Our bytes have eight bits, providing us with 256 possible characters in the ASCII code. Plus a start, a stop, and a parity bit. That's 11 bits total for each byte.

But what if we were to assign a number for each word in the English language?

Number 87 on your Feedback card

Propagation

Jim Gray W1XU
210 E Chateau
Payson AZ 85541
[jimpeg@netzone.com]

The best (G) days for radio propagation are likely to be the 3rd–5th and 14th, while the worst (P or VP) are likely to occur from the 17th–20th and again on the 23rd or 24th. The remaining days are either Fair (F) or trending as shown on the calendar.

Remain alert during the 17th–20th for other geophysical effects on Earth, including earthquakes, volcanism, and unusual weather conditions. An early winter is possible in the northern US, beginning mid-month.

As this is written (mid-August) solar flux unexpectedly remains in the 70s, having shown few signs of increase for nearly two years ... resulting in stagnant DX conditions with few golden opportunities.

10–12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15–17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the US.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30–40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar), and also short-skip during hours of darkness to 1,500 miles or more.

160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked (G) on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet. W1XU. 73

NOVEMBER 1997

SUN	MON	TUE	WED	THU	FRI	SAT
						1 F
2 F-G	3 G	4 G	5 G	6 G-F	7 F	8 F-P
9 P-F	10 F	11 F-G	12 G-F	13 F-G	14 G	15 G-F
16 F-P	17 P	18 P-VP	19 VP	20 VP-P	21 P-F	22 F-G
23 G-F	24 F-P	25 P	26 P-F	27 F	28 F-G	29 G-F
30 F						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20					20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

Using 17 bits we'd be able to define 131,072 words, plus the start, stop and parity bits would give us 20 bit superbytes. That would enable us to send a word with 20 bits instead of 66 bits, a 3.3 times improvement in throughput.

This would have the added value of making the translation to any other language automatic. Backwards, of course, some sentences would be. But we can live with that.

Our computers would have no problem in handling shorter bytes for numbers, punctuation, and special characters. If the byte comes through with 20 bits it's a word. If it's 10 bits it's not.

Just because we're still stuck with the hundred-year-old typewriter key arrangement doesn't mean we have to keep living with the old ASCII character set forever. In case you've forgotten, the keys were arranged to slow down typing so the typewriter wouldn't jam with a fast typist. 73

Including Ham Radio Fun!

DECEMBER 1997
ISSUE #447
USA $3.95
CANADA $4.95

International Edition

73® Amateur Radio Today

El Cheapo GPS Mag-Mount

Compact 80m Antenna

Kit Building Basics

Mobile HF Loop

Review:
Hamtronics TD-5

THE TEAM

Business Office
Editorial - Advertising - Circulation
Feedback - Product Reviews
73 Amateur Radio Today Magazine
70 Route 202N
Peterborough NH 03458-1107
603-924-0058
Fax: 603-924-8613

Reprints: $3 per article
Back issues: $5 each

Printed in the USA by
Quad Graphics

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article [IBM (ok) or Mac (preferred) formats], carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

DECEMBER 1997
ISSUE #447

73 Amateur Radio Today

Including Ham Radio Fun!

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

REVIEW

HAM RADIO FUN SECTION

On the cover: Peppy new SX-20 Sidebander amateur HF SSB/CW transceiver features Direct Digital Synthesis, dual VFOs, built-in iambic keyer, selectable tuning speeds, and much more. Available assembled or as kit from Ramsey Electronics. *73* HQ's Christmas tree features lovely elfette Melanie Carey, daughter of Circulation Manager Linda Coughlan. Assembled form only, (sorry) not available. Happy Holidays!

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107.

The subscription rate is: one year $24.97, two years $44.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, 70 N202, Peterborough NH 03458-1107. 73 Amateur Radio Today is owned by Shabromat Way Ltd. of Hancock NH.

Contract: By being so nosey as to read this fine print, you have just entered into a binding agreement with *73 Amateur Radio Today*. You are hereby obligated to do something nice for a ham friend—buy him a subscription to *73*. What? All of your ham friends are already subscribers? Donate a subscription to your local school library!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

The Magnet Motor

For doubters, here's a photo of me (**Photo** A) on the Takahashi magnet-powered motor scooter on my last visit to London. Yes, it uses a small battery to start the motor, but from then on the magnet motor not only powers the scooter, but also recharges the battery. And it goes like a demon.

I admit that I don't know much about magnets. But even so, I just don't understand how it is possible to take energy out of magnets without demagnetizing them. I keep asking myself the question: Where's the energy coming from?

We know now that cold fusion gets its excess energy from the transmutation of elements, which is not really fusion, unless it's occurring on a microscopic (or smaller) level. So what's going on with magnetic motors? I've watched one over-unity theory after another evaporate when closely investigated. I've yet to see any substantiation for the zero-point energy concept. I have yet to meet anyone who's seen an N-machine generating power.

Yet the Takahashi scooter really scoots! And Dr. Takahashi has excellent credentials. He developed the Sony Trinitron™ and Walkman™, and has a string of remarkable patents. I've seen the scooter. I've driven it. But I just don't understand how it can run, and run, and run.

***Photo A.** The Takahashi magnet-powered motor scooter goes like a demon!*

Big Brother

A clipping from Jim Kocsis WA9PYH waves a flag for any entrepreneurial experimenters out there. Any left?

It seems that GEICO, the auto insurance company, lent almost a million bucks to Laser Technology Inc. (LTI), an outfit making laser speed detectors for the police. The idea was to develop a new feature for the guns which would record a car's speed and capture a video image of it. They're working now on a character recognition (OCR) system which would make it so the police could set up the system anywhere and have it automatically mail out speeding tickets. This would be an incredible revenue generator.

This has nothing to do with safety and everything to do with generating money, both for the towns and for insurance companies, since their premiums automatically go up when you get a speeding ticket—which explains GEICO's investment.

Your job, oh great inventor, is to come up with a product that will blind the video camera—perhaps high intensity IR LEDs?

A few years ago I gave you a golden opportunity to get into the business of jamming police radar when I published an article on a gadget that would do this, and do it legally. But you just sat there and did nothing, as usual, letting someone else put the product on the market and make a killing. Tsk.

Skip This

Yes, I've been thinking again, so you really ought to skip down to my next item and not bother your head with this stuff.

Anyway, one of the guests on a recent Art Bell show was Johnny Holland, who's been involved with the parapsychology lab at Princeton University (PEAR). I've mentioned their work before, but this is the first time I've heard a first-hand report from anyone.

Holland mentioned that they discovered that if their test subjects were given the answers to the questions they were asked after the test was over that this seriously affected the test results. That's right, there was precognition involved.

Well, so much for not learning from history. Back in the 1940s I worked as chief engineer and announcer at WEEB in North Carolina and one of the other announcers was William Cox, who was helping Dr. J. B. Rhine with his parapsychology experiments. So naturally I helped with many of the experiments. Along about 1949 Rhine discovered the precognition problem, which meant that he had to throw out all of his research data and start over again, making sure that his test subjects were never given the correct answers.

So the guys at Princeton, having not done their homework by reading Rhine's books and other reports, had to painstakingly reinvent the wheel.

Yes, the PEAR group has conclusively demonstrated the weird powers of the mind, including psychokinesis, where the mind is able to influence matter. They have a computer program on their Web site which will allow anyone to prove to themselves that they, too, can influence matter with their minds. Try [jh@pearinc.com] and see how much you can influence white noise to make a picture.

One of the things I've editorialized in the past has been the question of where our memories are stored. We know that some people who've lost over half of their brains in accidents still have their memories. And other people, who've lost the other half of their brains, still have their complete memories. And then we look at the quantity of storage needed to keep a lifetime of memories of everything we see, hear, feel or experience, and we run out of storage space in anything we can imagine.

I propose that our memories are stored outside of our

physical bodies. This would also help explain the reports from thousands of people who've had near-death experiences and tell us that when we go to the other "side" we still have all of our memories. This is why these people, when they come back, start getting busy educating themselves. They tell us that we're here to learn things, not to take as free a ride as we can, watching ball games and drinking beer through life.

When you die one of the first things that happens is a full life review, complete with your feeling how what you've done and said has felt to others.

Several of the books in my guide to "books you're crazy if you don't read" have to do with life and death. There's *The Secret Life of Plants*, which explains how plants and people communicate. Then there's Boone's *Kinship of All Life*, which explains how you can communicate with any living thing, right on down to a fly. As I've mentioned, I've never had to swat another fly since reading that book. Sir Crookall's *The Supreme Adventure* shows the similarity of the dying process as reported by near-death experiencers and from the departed, reporting back through psychics on the next "plane."

Then there's the amazing book by Mae Sewall, *Neither Dead Nor Sleeping*, which chronicled her communications with her dead husband and pianist Artur Rubinstein.

When I was a practicing psychologist I found there was no problem under a light hypnosis to get my patients to recall any moment of their lives in full sound and color. And that included memories of sounds and feelings during the nine months before birth. Further, it was no more difficult to regress them to past lives, complete with minute details. No, they were not famous people, just peasants and farmers. The few cases where I took the trouble to check the facts recovered from these sessions showed them to be accurate.

Sewall explained that on the "other side" they are busy writing, inventing, and so on, and then passing this stuff on to us. Which could explain why most of the famous composers have said that their music has come to them in a dream state, all ready to be written down. We hear the same story from writers and other creative people. Perhaps creativity is mostly an ability to relax one's mind and open a channel for such communications with those who would help us.

Sewall explained how her husband and Rubinstein were able to influence events in our world, getting her speaking tours whenever they needed for her to have money to help with one of their projects. Putting this together with precognition raises questions about our so-called free will. How free are we?

I realize that we are, essentially, prisoners of our past and that our so-called decisions are probably completely governed by our experiences. But then there's the serendipity factor which can change everything for us. And, as Scott Adams explained in his latest book, *The Dilbert Future*, we have the weird power to have some control over serendipity.

Well, I've rattled on at length, as usual, so perhaps it's time to stop trying to get you to actually think.

The Ice Caps Are Melting! The Ice Caps Are Melting!

Yes, the end of the world is near, with the carbon dioxide buildup, the growing ozone hole, and the ice caps melting. We're doomed, doomed!

Well, maybe. But as far as the ice caps melting goes, reader Roger Cerney from Colusa, California sent me some photos taken in 1989 by a friend of his who went to Antarctica to install antennas (**Photo B**). The 120-foot towers installed in 1960 were by then almost buried under the snow, with only 15 feet left showing. The tip of a crane was still showing, but it's buried now until the next thaw.

If you miss having something to worry about, you might consider that the south polar ice cap is way off center, so as the snow builds up it'll tend to wobble the earth more and more, eventually turning it around suddenly so the poles end up in the tropics, and the tropics at the poles.

There's abundant evidence that this has happened before, so you might want to at least worry a little. There's isn't a lot you can do beyond that. Well, you could learn to swim real good so you'll be ready for the five-mile-high waves that are predicted to wash over most of America.

Biocommunications

Maybe we don't need radio and the ionosphere, or satellites, to achieve instant communications anywhere in the world. Or a ham ticket, for that matter. The communications medium is there, it's just that as far as I know, no one has done much about investigating its potential.

Some months ago—maybe a couple of years by now—I reviewed a book by Robert Stone called *The Secret Life of Your Cells*. As I explained, I found *The Secret Life of Plants* so interesting that I called Cleve Backster, the chap who'd done the original research on plant-human communications. I figured he must have made some progress in the 20 years since the plants book. I was right. He put me in touch with Brian O'Leary, who'd been working with him on human cells and their ability to communicate with each other. And Brian put me onto the Stone book.

Plants, in some way, are able to communicate with each other, and with humans. Well, we know that when we speak to them and tell them what wonderful plants they are, they grow faster and taller. You doubt it? Then just try it with a couple beans in pots. Tell one how great it is going to be and how much you're going to like it. Tell the other how ugly it is going to be and how you are going to hate it. You'll be amazed at the difference.

Backster and O'Leary found that when they took some cells from a person's mouth, put them in a petri dish to grow, and then put a meter on them, that the meter worked in tandem with another meter connected to the person whose cells were used. Even thousands of miles away!

What we don't know is the speed at which this communication takes place, which I suspect is instantaneous. Yes, faster than light. We also don't know what bandwidth we can develop using this approach. If we modulate a human (or perhaps even an animal or plant) cell with light, can we then demodulate another cell from the same living source?

This cellular communications explains the experience of a woman who had an organ transplant from a young man

Continued on page 39

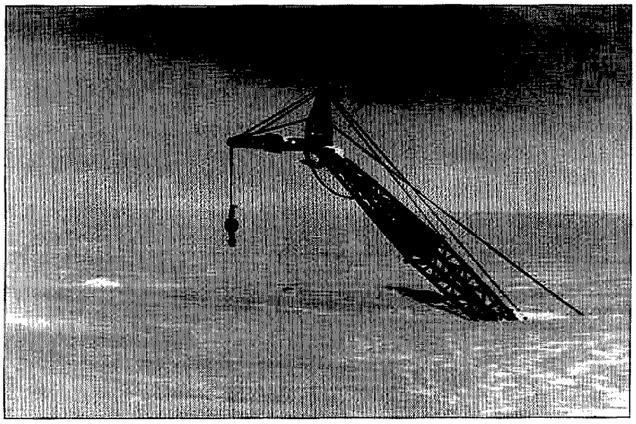


***Photo B.** Almost 40 years later, only a tenth of the crane is visible above the snow.*

QRX . . .

Extra Special 9-Year-Old

Rebecca Rich KBØVVT of Raytown, Missouri, has attracted quite a lot of attention recently—and deservedly so.

For starters, few who see her suspect that the cute little youngster with the flowing red tresses is a licensed amateur. And when they do get past that surprise, how about this: She's an Extra! And if that's not enough, how many Extras do you know who reached that pinnacle at *age 8?*

But it's all true, thanks to hard work, love of ham radio, and no doubt more than a little help from mom Barbara KGØUT and dad David KGØUS.

In fact, word of Rebecca's precocity is spreading. While on vacation with her parents In Maui during November 1996, unfortunately Rebecca had her Yaesu FT-51R stolen. This was not only a monetary loss, but a sentimental one as well—she had been given the HT as a reward for getting her General. Her father got the word out about the theft, but that was about all that could be done.

Or so everyone thought. Enter Yaesu, in the person of Mikio Maruya, Executive Vice President:

"We are sorry to hear of the misfortune that befell your family while vacationing on Maui ...

"We understand the FT-51R was a gift to Rebecca for earning her General Class license and that this radio was also her first ... We can appreciate that this radio must have been of great significance and sentimental value to her ...

Photo A. Rebecca Rich KBØVVT became an Extra when only eight.

"Nothing can ever truly replace Rebecca's original radio, but with your approval we would like to help lessen her loss by presenting her with a new complimentary FT-51R ...

'The future of ham radio is today's youth ... We hope that Rebecca will continue to enjoy her ham radio hobby for many years to come ... "

To Rebecca's delight, an FT-51R and ADMS-1c software package soon arrived.

And we hear that KBØVVT's fame continued to grow at last October's 50th Anniversary Convention of the QCWA in Kansas City. There, she was introduced by Bill Pasternak WA6ITF during his Future of Amateur Radio seminar and used as an example of what can happen when we help and encourage young people to get involved in amateur radio. Amen, Bill, and many congratulations to KBØVVT ...

20/20 Foresight

"I think there is a world market for maybe five computers."—Thomas Watson, chairman of IBM, in 1943.

Borrowed from *UTARC Newsletter*, April 1997, by way of June 1997's *Maple Valley Hamlink*, official newsletter of MVARC, Maple Valley WA.

A Condensed History of Capacitors

The capacitor, or condenser, in its original form, was known as the Leyden Jar. It was discovered in late 1745 and early 1746 by several people. Remember, at this time only static electricity could be generated, as Volta would not invent his pile for another 45 years and it would be 85 years before Faraday discovered how to generate electricity with magnetism.

Von Kleist, Dean of the Cathedral at Kamin in Pomerania (now parts of Poland and Germany), wrote on November 4, 1745, about a small vial in which he had placed an electrified nail. He noticed that he could only obtain a shock from it when he held the vial in his hand. He concluded that the human body must have something to do with it.

In January 1746, a man named Cuneus, assistant to professor Peter Van Musschenbrock, at Leyden, Holland, received the next shock. Musschenbrock theorized that the reason electrified bodies lose their charge was because of the air around them, so he tried to charge water contained in a glass jar. The idea was that the glass would Insulate the water from the air. Cuneus was holding the jar In his hand when it was disconnected from the static electricity machine—he received a large enough shock that he dropped the jar. When the experiment was repeated, it took Cuneus two days to recover, after which he stated that he would not repeat it again for all of France [*a rather peculiar threat—ed.*].

Later in 1746, a Dr. Bevis in Britain improved the design by coating the outside with tinfoil and suspending a metal chain from the cover to the water. His next step was to eliminate the water, replacing it with metal shot. And to prove that the form of the jar had nothing to do with the principles involved, he took a flat sheet of glass and coated each side with tinfoil to within an inch of the edge. It worked just as well as a jar with the same area.

Dr. Watson, a London apothecary and physician, showed that the force of the shock was increased when the glass was thinner, and established the law that the force of the charge was proportional to the area of the coated surface and to the thinness of the glass. The Leyden Jar became a scientific novelty, and large numbers of electricians traveled around Europe shocking people.

The abbot of Nollet entertained ladies of the French court by killing birds with the discharge. To amuse the king, the abbot sent a discharge through 180 guardsmen in order to watch them all jump simultaneously. Later he did the same thing to a circle of monks 5,400 feet in diameter.

When the novelty wore off, serious study began. In 1748, Dr. Watson formed a two-mile circuit of wire and announced that the amount of time necessary for electricity to pass through it was "altogether inappreciable."

In 1746, Benjamin Franklin had announced his theory that lightning and electricity were identical. He was ignored and ridiculed. In 1750, he suggested using pointed iron rods as conductors to draw lightning from the clouds. In 1752, he performed his famous kite experiment with a Leyden Jar, and eventually was made a Fellow by the Royal Society because of his work. He proved Bevis correct: Energy was actually stored in the glass. It was left to Faraday many years later to define and measure the dielectric constant.

Volta later gave the name condenser to the device, as electricity was considered to be a fluid that could be condensed. When Marconi signaled from Poldhu to Glace Bay, he used a battery of classically designed Leyden Jars that were later replaced by condensers. The name was changed to capacitor sometime after 1938—perhaps around 1948. [*Anybody know?—ed.*]

From an article by Jim Boyer KB9IH, in *Squelch Tale*, official newsletter of the Chicago FM Club, Inc., October 1997.

Greek to You

Greece's *Radio Telecommunications Magazine* has announced two new Hellenic Awards. Publisher Nick Cassimis SVØCY/KD2IR tells us that the CW and SSB awards can be obtained

QRX

Continued from page 6

by having two (2) confirmed contacts with each of the SV1 through SV9 regions (18 contacts per award). To apply, send QSL copies and $10.00 (US) per award to *Radio Telecommunications Magazine,* Hellenic Award '97, 165 Egeou Street, 17124 Nea Smirni, Athens, Greece. For further info, use E-mail [radiotel@hol.gr] or FAX (011) 30-1-975-3304, or visit their Web site at [http://www.radiomagazine.com].

A DXer's Night B4 Christmas

By Ward Silver
[hwardsil@wolfenet.com]

'Twas the night before Christmas
And all 'cross the bands,
No DX was stirring
From Brazil to Japan.

My antennas were pointed
With painstaking care,
In hopes that a new one
Soon would be there.

The family was nestled
All snug in their beds,
While visions of TVI
Danced in their heads.

In my slippers and sweater,
Chores finally past,
I'd just settled in
For DXing at last.

When out of the speaker
There arose such a ruckus,
That I grabbed for my 'phones
To see who the DX was.

Down to the low end
I tuned in a flash,
And switched in a filter
To get rid of some hash.

With the shack in the light
Of the amplifier's glow,
I tuned up and down
Hoping DX would show.

When what to my wondering
Ears did appear?
But a rapid-fire pileup
With DX in the clear!

As DXers clamor,
Calling low and then high,
When after a rare one
Raise a great hue and cry.

More rapid than popcorn
The callsigns they came,
And he heard them, and logged them,
And called them by name.

"OH and PY and Hotel Charlie
Eight,
JA and ZS and a Washington State!"

"All forty zones
and six continents, too.
I can copy you all!
It's a marvelous zoo!"

I could tell he was rare
From that fluttery sound.
And I heard him quite clearly
As he turned it around.

"GM GE ES BEST DX TOO
QSL VIA BURO ES BCNU"

His fist, how it sparkled,
His callsign, sent well,
Made his signal to ring
Like the sound of a bell!

He worked through the callers
Like a championship.
And even tailenders;
Worked 'em lickety-split.

I wasted no time and
Went straight to my work,
Calling up three
Where the big signals lurk.

My call came right back
Like he knew I was there.
The code crackled over
The cold winter air.

And then it was over,
It was down in the log.
I filled out my card
And sipped some eggnog.

But I heard him exclaim
Before calling anew,
"Merry Christmas to all,
Listening up one to two!"

73, Ward NØAX

Photo B. This beautiful Greek certificate could be yours.

Top Ten Reasons for Working Phone

10. You can work your neighbors at the same time, via their TV sets and telephones.
9. I can never think of anything to say on CW.
8. The Q codes sound really cool when you say them out loud.
7. My kids think I sound like Donald Duck on SSB.
6. Umm ... I can't find my key.
5. On phone I can usually tell if the operator is of the opposite sex.
4. I can use either Upper Side, or Lower Side, or *both!*
3. On phone, if somebody has trouble copying me I can just turn up the mike gain and shout.
2. A phone signal occupies like a jillion times as much bandwidth as a CW one, so more people will hear me.

And the Number One Reason for Working Phone:

1. I love the sound of my own voice, so let *everybody* hear it!

From *Low Down*, official journal of the Colorado QRP Club (cqc@aol.com); originally in *Key Note*, FISTS CW Club, Hadley MI.

Number 10 on your Feedback card

Distributed Capacity Folded Loop

This ceiling-mount mobile antenna will really go to your head!

John Portune W6NBC
724 Celestial Lane
Foster City CA 94404
[John_Portune@mail.sel.sony.com]

If you own a Fiberglas™ pickup shell, motorhome, or boat, this compact 40-meter mobile loop will compare favorably with a mobile whip antenna. What's better, it's invisible from the outside of the vehicle.

Over the years, the ham community has ignored small transmitting loops for the HF bands. Today, however, we live in a shrinking world. Everything is smaller: our rigs, our cars, even our QTHs.

I was curious. Would a loop work well there? Could it compete with a conventional HF whip antenna?

To answer this question, we need to get back to basics, to understand the fundamental strengths and weaknesses of both types of antenna.

Key principles

Compact transmitting loops and mobile HF whips are usually considered small antennas. Their total size is less than roughly 1/4-wavelength. How well each performs depends heavily on three key issues: (1) radiation resistance; (2) coupling field size (my term); and (3) antenna height.

In a full-sized antenna like a dipole, radiation resistance is comparatively high—about 73 ohms. In a compact loop or a mobile whip, the radiation resistance is much lower. Here are the formulas for the radiation resistance for a small loop and a short vertical whip (without loading coil or capacitive hat):

Loop
Rr = 19500 x $(D/WL)^4$

where
Rr = Radiation resistance in ohms
D = Diameter of loop in meters
WL = Wavelength in meters

Whip
Rr = 392 x $(L/WL)^2$

where
Rr = Radiation resistance in ohms
L = Length of whip in meters
WL = Wavelength in meters

To illustrate, **Table 1** translates the loop formula into real numbers. Notice how rapidly radiation resistance decreases with size. Why is this important? In the theoretical world, it isn't. An antenna with low radiation resistance, like a loop or a mobile whip, can radiate just as well as an antenna with high radiation resistance, like a dipole. The only difference will be the voltage and current in each antenna.

In the real world, however, antennas also have conductor resistance. The metal in an antenna is not perfect. All

Loop Diameter (Feet)	Rr (Ω)	Cr (Ω)	Efficiency (%)
10	0.49	0.089	85
9	0.32	0.080	80
8	0.20	0.071	74
7	0.12	0.062	67
6	0.064	0.053	55
5	0.031	0.044	41
4.5	*0.020*	*0.040*	*33*
4	0.013	0.035	27
3	0.004	0.027	12
2	0.0008	0.018	4
1	0.0000	0.00089	0.05

Table 1. *Radiation resistance (Rr), conductor resistance (Cr), and efficiency of loops made of 3/4-inch (0.9-in. OD) copper pipe at 7 MHz.*

metals exhibit resistance. The problem is that it's in series with the radiation resistance. Transmitter power gets divided between the two. The part that goes to conductor resistance is wasted as heat. The portion that gets to the radiation resistance is the useful part. It becomes radio waves.

The real culprit is skin effect, the well-known tendency of RF current to flow only on the surface of a conductor. Here is that formula:

$$R = 0.00096 \times \sqrt{(F/D)}$$

where
R = Conductor resistance in ohms/ft
F = Frequency in MHz
D = Conductor diameter in inches

Again, I'll give this equation some real numbers. For example, let's take a large conductor, 3/4-inch (0.9-inch OD) copper water pipe. At 7 MHz, conductor resistance is 0.0028 ohms per foot. That's not much, you say. Take a look at the third and fourth columns of **Table 1**. Even with a conductor this large, for loops smaller than five feet the conductor resistance is actually greater than the radiation resistance. Instead of being a minor problem, skin effect eats us alive in compact loops.

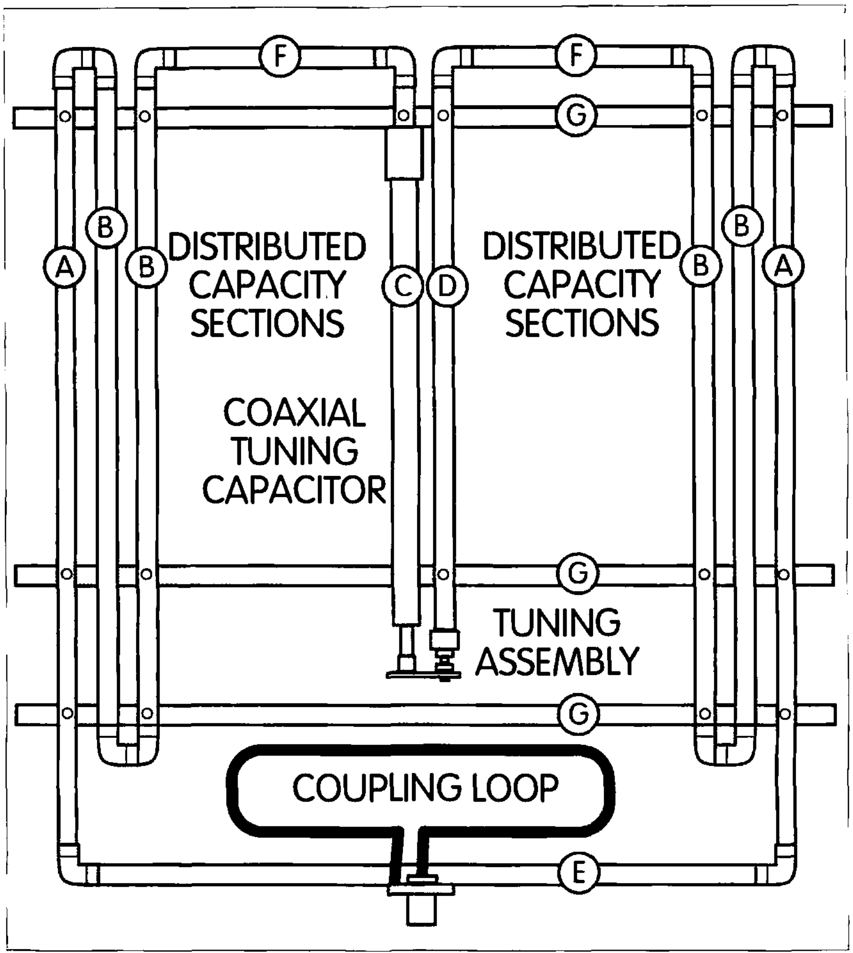


Fig. 1. The distributed capacity folded loop.

Two additional concerns

What's more, even the type of metal we use to build a loop is important.

Silver	0.94
Copper	1.0
Gold	1.4
Aluminum	1.6
Chromium	1.8
Zinc	3.4
Brass	3.7 – 4.9
Tin	6.7
Steel	7.6 – 12.7
Lead	12.8

Table 2. Relative resistivity of common metals, compared to copper.

I've listed the relative resistivities of some common metals in **Table 2**. I've included silver and gold for curiosity more than practicality. Gold is interesting, however. You might think that it would be the best conductor. Surprisingly, both silver and copper are better. We use gold on connectors not because of superior conductivity, but because it resists corrosion.

Copper is really the only choice for a loop. Even aluminum, which is suitable for larger antennas, has 60% more resistance. We can't afford this when we are fighting skin effect in a loop. Other metals are worse.

Perhaps you are thinking about silverplating. It's a good idea at much higher frequencies, but at 7 MHz the skin depth is too thick. Plating does not become practical until we are operating at UHF frequencies.

Also, the shape of the conductor is important. Round is best. A flat strap, for example, suffers much more from skin effect than a round conductor. Not only does the RF current move outward, it also moves to the edges.

For most small loops, 3/4-inch household copper water pipe is the most reasonable choice. It has moderately low conductor resistance and it's inexpensive.

A mobile whip

Whips don't suffer as badly from conductor resistance loss. In the equations above, you'll notice that the radiation resistance of a loop decreases in proportion to the fourth power of diameter. For a whip, it's only the second power of length. The radiation resistance and the efficiency of a typical 40-meter mobile whip are much higher than for a comparable loop. Does that make a whip better than a loop for mobile? Not necessarily.

In theory, a 1/4-wavelength mobile whip antenna is not a complete antenna. It is physically only half a dipole. It's often called a monopole. The missing half of the antenna exists, but it's a mirror image of the real half of the dipole in the ground plane under the monopole. Without it, the monopole would not function. The coupling field from the real half of the antenna becomes RF currents in the ground plane to complete the electrical circuit of the antenna.

If the ground plane under the antenna is a perfect conductor, the monopole will radiate just as well as if the other side of the dipole were actually present. In the typical mobile situation, however, the ground plane is terrible.

At HF frequencies, the vehicle's body is much too small to be the entire ground plane. The coupling field even for a short whip is many meters in diameter at 7 MHz. Contrast this with VHF, where the coupling field is only roughly a meter in diameter. Here the car body can provide the complete ground plane.

Soil makes up most of the ground plane at HF. Compared to a metal car body, soil is a poor conductor. It varies with location, but soil resistance is always at least 10 ohms, even in the best case.

Like conductor resistance, the soil resistance is in series with the radiation resistance, and the power again gets divided. At HF, most of the transmitter's power only heats up worms.

A mobile loop

In contrast, a mobile loop does not suffer in the same way. First, it isn't half an antenna like a mobile whip. The coupling field can make a complete circuit in space. Part of it does not have to become currents in the soil. The other half of the antenna is physically present.

The second reason is the size of the coupling field of a loop compared with a whip. Because the ends are folded back in a loop, the coupling field is mostly confined to the center of the loop. This makes it much smaller than the coupling field of a whip. Without going into the math, my loop's coupling field is roughly the same as a tiny 12-inch dipole's. The loop's energy becomes a radio wave long before it ever reaches the soil.

Does this mean that a loop is better for mobile operation? Again, not necessarily. There is more to the story. Here's where we get to antenna height.

Like any antenna, a loop works best in free space, far away from surrounding objects. Anything that you place near an antenna induces losses and lowers its efficiency.

Because of its very small coupling field, the electric and magnetic fields of a loop are more intense than for a whip. In free space this would not be a problem. Due to its shape, however, we normally have to mount a loop close to the metal body of the car.

For the whip, the metal body is an asset—it improves the ground plane. But for the loop, it is a disadvantage. Near the metal body of the car, losses induced by the loop's intense magnetic field are unfortunately quite high.

It is just easier to get a whip higher in the air than a loop. Notice the photo of my truck. The whip on average is several feet higher than the loop, so it is less of a "grounded" antenna.

What can we conclude, then? Is one antenna the clear winner for mobile operation? Frankly, no. A whip is easier to get higher in the air, and it suffers less from conductor resistance loss. However, it suffers badly from soil resistance loss. Also, it's ugly.

A loop does not suffer from soil resistance loss and is aesthetically much more attractive, at least from the outside of the vehicle. It, however, suffers badly from magnetic loss in the car's body. Therefore, both antennas are very highly compromised by the

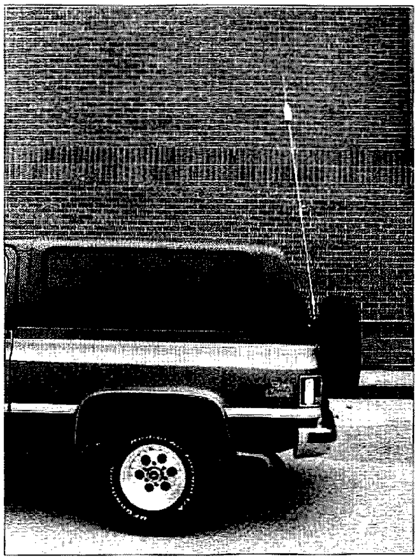


Photo A. *Truck with 40-meter Hustler mobile whip. Loop not visible, inside.*

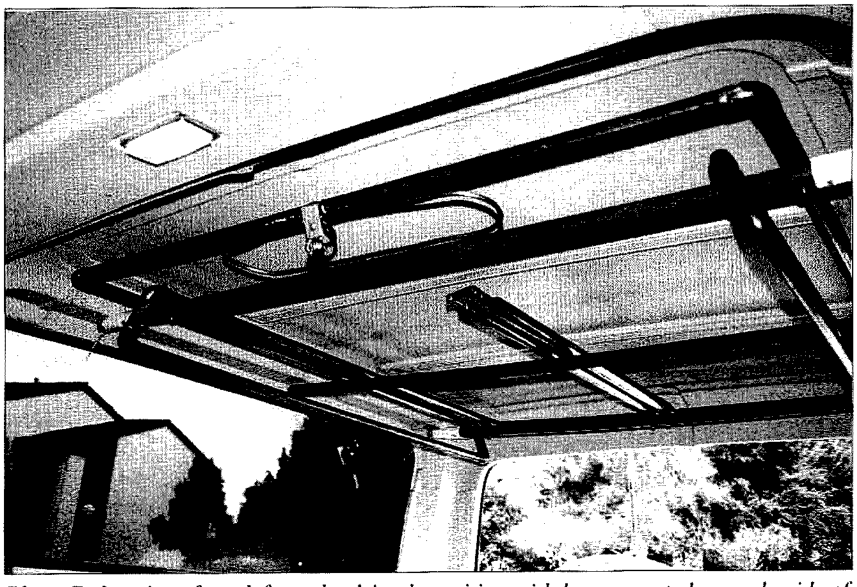


Photo B. *Interior of truck from the driver's position with loop mounted on underside of Fiberglas shell. Mount loop with connector forward.*

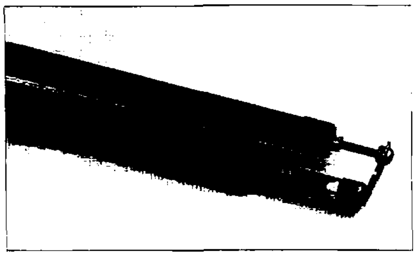


Photo C. Close-up of the tuning assembly of the coaxial capacitor.

mobile environment. Neither is significantly better than the other.

Later in this article, I will share with you my personal comparisons of the two antennas, based on operational experience. Like most antenna articles, the proof of the pudding comes from using the antennas on the air. I will say here, though, that my experience with the loop has been quite good.

Designing the mobile loop

Now that we are armed with all this theory, let's design the loop. The first consideration in the mobile environment always is space. Realizing that big is better, I made the loop as big as I could. It had to fit on the underside of the Fiberglas shell of my truck. It's a rectangular loop 47 by 51 inches, but I made it a little smaller than necessary so that it would fit on a smaller truck (my pickup is a full-sized model).

Loops, incidentally, do not have to be round. Shape isn't important. Only the total area of the loop matters. That's what couples to space, not the shape. For calculating purposes, my 47- by 51-inch rectangular loop is roughly equivalent to the round 4.5-foot loop shown in the figures.

You will notice from **Fig. 1** that the loop is more that just a simple loop. There is a good reason for this, and I will get to that shortly. First, however, we need a little more theory.

The tuning capacitor

A small loop antenna is essentially a parallel tuned circuit, an inductor in parallel with a capacitor. By making the inductor physically large enough to have usable radiation resistance, the circuit will act as an antenna. Making the inductor into a single-turn loop accomplishes this nicely. Then, by adding capacity across the ends of the loop, usually in the form of a tuning capacitor, we bring the circuit to resonance.

The capacitor, however, is the difficult part of this design. Remember, voltage and current in any small antenna are high. My loop has a radiation resistance of roughly 0.02 ohms. A dipole, at 73 ohms, is almost 4000 times higher. The voltage and current multiply by this ratio. In a small loop they can reach tens of thousands of volts, and many dozens of amps. It takes a very substantial tuning capacitor to withstand this.

So I set out to do something about the tuning capacitor. Could I eliminate or minimize it? The answer to both of these is yes. By taking advantage of another characteristic of all antennas, I eliminated the conventional tuning capacitor entirely. In theory, all coils also possess a small amount of capacitance. We call it *distributed capacity*.

If we could make the loop large enough, the distributed capacity would bring the loop to resonance all by itself. Loops are naturally self-resonant, without a capacitor, at a circumference of roughly 1/4-wavelength. On 40 meters, this would be a loop roughly 10 feet in diameter.

A 47- by 51-inch loop is too small to be self-resonant at 7 MHz. I measured mine with an FET dip oscillator. It resonated at 21–22 MHz without a capacitor. If I had wanted to use it on 15 meters, that would have been fine. I mostly work 40 meters mobile, however.

So I added more conductor. To maintain the required 47- by 51-inch size, I folded the extra length back. Notice **Fig. 1**. This is an old trick to increase distributed capacity that I read in a 50-year-old antenna textbook. The self-resonant frequency now dropped to between 13–14 MHz. Again, if I had wanted to work 20 meters, I would have been close.

Then by extending the ends of the loop downward, to form a linear capacitor, as shown in **Fig. 1**, I lowered the resonant frequency a couple more MHz. I was getting close. A small air-variable would have taken me the rest of the way, had I wanted. My objective, however, was to completely get rid of the conventional tuning capacitor.

You'll see my final solution **in Fig. 1**. It's a coaxial capacitor also made of copper pipe. It's inexpensive and you can make it yourself. You won't have to locate a large, expensive tuning variable. This capacitor will handle a 100-watt mobile transceiver. I haven't tested its maximum power handling capacity. If you want to run more power, all you have to do is use larger pipes for the capacitor.

Tuning the loop

As you can also see, I made the center conductor of the coaxial capacitor adjustable like the slide of a trombone. With this arrangement I can tune the loop to any segment of the 40-meter band. Yes, the loop is a fixed-frequency

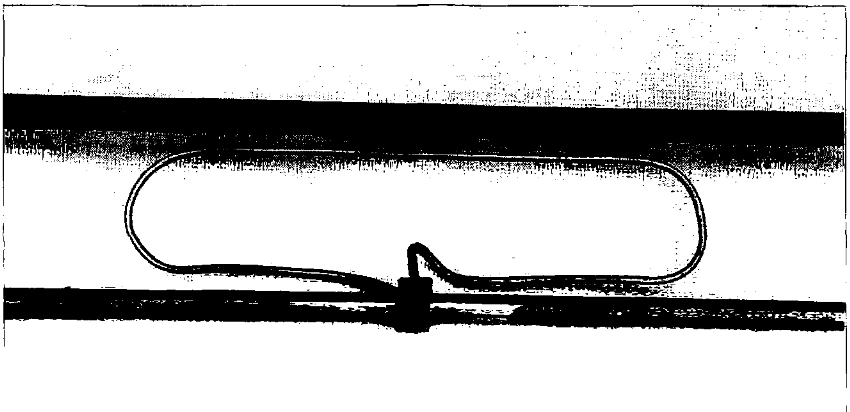


Photo D. Close-up of feed loop, made of soft quarter-inch copper tubing. Solder one end directly to main loop near connector. Solder other end to the center pin of the feed connector.

device, but so is my mobile whip. I have to change the length of the whip for a different band segment. Where's the sin in doing the same for a loop? In my particular vehicle, the tuning adjustment is right behind the driver's seat.

Also, like any small antenna, the loop is extremely sharp in tuning, but so is my whip. Any small antenna that isn't sharp isn't efficient. A small antenna that is broad has high losses. It's a law of physics. Incidentally, from bandwidth alone I know that the two antennas are very similar in total efficiency.

With the loop or the whip, you must operate within roughly a 25 kHz window to stay below 3 to 1 SWR. Otherwise, you will need to move the adjusting assembly. For convenience, you could parallel the coaxial capacitor with a small wide-spaced variable. 20 picofarads would be adequate.

Automatic antenna tuners

While I'm talking about bringing the loop to resonance, let me say something here about automatic antenna tuners. While it is theoretically possible to feed a loop with an automatic antenna tuner, it's not a good idea. You'll have the same problem if you use a tuner with a loaded whip. The tuner is able to provide a matched load for your rig. It won't, however, necessarily maintain the efficiency of the antenna. Worse yet, you may damage your tuner.

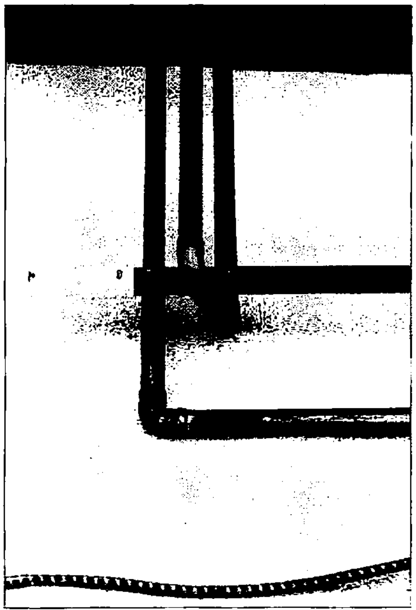


Photo E. Close-up of the end of triple pipe sections at the sides of the loop, showing how to orient pipes and elbows. These sections increase the distributed capacity of the loop and lower its self-resonant frequency.

For a loop or small loaded whip to work properly, high circulating currents must flow. Remember, it has low radiation resistance. Once we tune out the reactance, high currents will flow in the low radiation resistance. We don't, however, want these high currents in the tuner. If you use a tuner to cancel the reactance as you move frequency, some of the high current will begin to flow in the tuner and in the transmission line. Neither may be able to stand it. It is best to bring a loop or mobile whip to resonance by reactance located in the antenna, not in a tuner. That's why the commercial loops have heavy-duty motor-driven tuning capacitors in them. In my particular case, I tune the loop by distributed capacity and the coaxial tuning capacitor. Both are part of the loop.

Feeding the loop

To couple the loop to your transceiver, you will need a feed network. Most conventional feed techniques work well. I tried a gamma match, a shunt match, a capacitive match, and a loop match. All of these worked, once I got them tamed. The easiest method proved to be loop coupling, however. You can see the details in **Fig. 1.**

To my surprise, the shape size, location, and wire size of the coupling loop are not critical. For durability, I made it out of 1/4-inch soft copper tubing. Make it roughly one-quarter of the diameter of the main loop. Mine is a rounded rectangular loop roughly four inches by 18 inches.

The most convenient place to locate it appears to be at the midpoint of the main loop. Here the impedance is very low. Solder the grounded end of the coupling loop directly to the main loop, as shown. Mount the feed connector on a small copper strap also soldered to the main loop.

Key	Qty.	Item
A	2	49-inch lengths, 3/4" copper pipe
B	4	45-inch lengths, 3/4" copper pipe
C	1	35-inch length, 1" copper pipe
D	1	36-inch length, 3/4" copper pipe
E	1	43-inch length, 3/4" copper pipe
F	2	18.5-inch lengths, 3/4" copper pipe
G	3	47-inch lengths (min.), 3/4" schedule 80 PVC pipe
	4	3-inch lengths, 3/4" copper pipe
	1	18-inch length, 1/2" copper pipe
	14	Elbows, 3/4" copper
	1	Reducer, 1" to 3/4" copper
	1	End cap, 3/4" copper
	1	End cap, 1/2" copper
	1	Strap, 1/2" x 2-1/2" x 1/16" flat copper
	1	Screw, 1/4–20 RH brass
	3	Nuts, 1/4–20 brass
	15	Screws, 10–24 x 2-1/2" RH brass
	15	Nuts, 10–24 brass
	5	Feet of tubing, 1/4" copper
	1	SO-239 connector, chassis mounting
	Teflon™ for insulators (see text)	

Table 3. Parts list for folded loop.

Constructing the loop

Cut all the copper pipe pieces to size according to the parts list. Make the center conductor of the coaxial tuning capacitor roughly a foot longer than specified. You'll need this for final tune-up. Then assemble the entire loop unsoldered, flat on the floor. Before soldering the pieces together, you will need to get a good picture of how everything fits.

Pay particular attention to the three parallel pieces at the sides of the loop. Note that the middle pipe does not lie in the plane of the loop, like the other two. When viewed from the top, the three side pipes form an equilateral triangle. Make certain to space the two that lie in the plane of the loop by three inches. Connect the elbows at the ends of the side sections with the three-inch pieces of pipe specified in the parts list.

Also, be careful to space the two pipe pieces in the center of the loop half an inch apart. This spacing is important in order to obtain adequate capacitance at the ends of the loop.

Then solder the entire loop together. Clean all connections thoroughly with steel wool and apply a coating of solder flux. This is important. I used liquid rosin flux, but the acid paste type is fine also. Use a propane torch. The biggest soldering iron will not be adequate. Any type of solder is fine. I used electrical-type.

Be careful not to allow too much solder to collect on exterior surfaces. Surface solder will reduce conductivity. Use a file to clean surfaces down to bare copper again. Afterwards, clean off the flux with solvent. It isn't necessary to polish the loop. Moderate surface corrosion will have little effect on performance. I spray-painted the loop to match the interior color of my truck.

Next, install the three pieces of schedule-80 PVC pipe. Their function is to keep the loop rigid. Drill holes through the loop and the PVC pipe for the screws. Do not, however, drill a hole through the coaxial capacitor. I used the PVC pipes to mount the loop in my vehicle. You may make them longer than specified for easier installation.

Now solder together the tuning assembly of the coaxial capacitor. Remember to solder a brass 1/4-20 nut inside the three-quarter-inch end cap that fits on the end of the loop. Use a stainless steel bolt and nut to hold the brass nut in place during soldering.

Then fabricate the insulators that separate the inner and the outer conductors of the coaxial capacitor. If you have access to machining facilities, turn them from Teflon™ or polystyrene.

A word of caution. Not all plastics are suitable. The electric field inside the capacitor is intense. Many plastics, PVC for example, exhibit too much dielectric loss. I constructed my insulators by wrapping heavy half-inch Teflon™ tape around the center conductor and securing the outer end with electrical tape. In any case, make the insulators as small as possible. Most of the capacitor's dielectric should be air.

Initial tune-up

For initial tune-up, a dip oscillator is most convenient. When you built the loop, you left the center of the coaxial tuning capacitor longer than required. With mine this way, the loop resonated at roughly 6.5 MHz. Then, with a tubing cutter, I shortened the center conductor in small increments until I brought it onto the 40-meter band. I performed the initial tune-up by hanging the loop on short ropes from the ceiling of my garage. You may want to leave the center conductor just slightly too long, to allow for final adjustment on the vehicle. The resonant frequency did not change much when I installed it in my truck, however.

Once you get the loop in band, an SWR bridge is sufficient to indicate the resonant frequency of the loop. The SWR bridge is a permanent part of my mobile installation. It dips sharply as I quickly tune across the band while applying very low power.

You will adjust the coupling loop in much the same way. First, tune the main loop to resonance. Then bend the coupling loop until the SWR is best. I was able to obtain an almost perfect match. The procedure is remarkably simple to

perform. Once you find the correct shape and position, you will never again have to adjust the coupling loop.

How well does the loop work? Very well, thank you. As I promised earlier, let me give you some comparisons between the loop and my mobile HF whip.

The whip is the popular Hustler™ mobile antenna with the large high-efficiency kilowatt resonator. It's mounted at the top center of the tailgate, on the spare tire rack. This is a good location because of the Fiberglas back on my truck. All of the whip is above the metal body. I installed a shunt-feed network at the base of the whip to be sure that the whip was properly matched to 50 ohms.

At the operating position, I installed a two-way coax antenna switch and two identical feed cables to make the comparison. In all cases I operated both antennas on the same frequency, very near the resonant frequency. Power was the same for all tests, roughly 100 watts RMS.

What did I find? To be honest with you, there isn't very much difference. Most of the difference is caused by the height of the loop compared with the whip. Being lower, the loop puts more of its energy straight up. Therefore, I noticed the biggest difference in ground wave contacts. Here the loop is usually an S-point weaker on both receive and transmit. For short skywave contacts, the loop is at times the same as the whip. On receive, the loop is less sensitive to noise. In terms of making an effective contact, this offsets the slightly weaker signal.

My conclusion is that the loop is a good mobile antenna. A large mobile whip may be a little better. The more compact types that are popular today would be the same. The loop obviously won't work on every vehicle, but for the ham with a Fiberglas truck shell, motor home or boat, the loop is certainly worth considering. It might be your best answer on a vehicle totally without a metal body. I want to try it on a large Fiberglas boat, for example.

I mounted my loop so that I could easily remove it from the truck. On camping trips it is an outstanding performer if I hoist it up into a tree. Give it a try—you won't be disappointed. 73

How to Silverplate RF Tank Circuits

A simple and inexpensive process to reduce losses.

Ronald Lumachi WB2CQM
73 Bay 26th Street
Brooklyn NY 11214-3905
[WB2CQM@juno.com]

In order to attain super-signal, top-gun status in the DX pileups, the big boys all utilize a number of well-known, high-performance, big-signal, high-ticket-priced pieces of equipment in order to maintain their razor's-edge status. Multi-element Big Bertha arrays on wide-spaced booms, state-of-the-art legal-limit Peter Dahl Hypersil-transformer-equipped amplifiers, and minuscule-loss transmission cable are routinely installed from the outset to maintain a signal that is a cut above the crowd. It doesn't end there! Antenna components are continually manipulated in order to attain that elusive 1:1 SWR, and controls are tweaked to gain every ounce of power from paired high-current monster ceramic tubes.

From the "What's left to do?" scenario, a question naturally arises. If everyone in that exclusive club is equal in signal intensity and operating expertise from the starting gate, what's left to do legally to go that one increment higher?

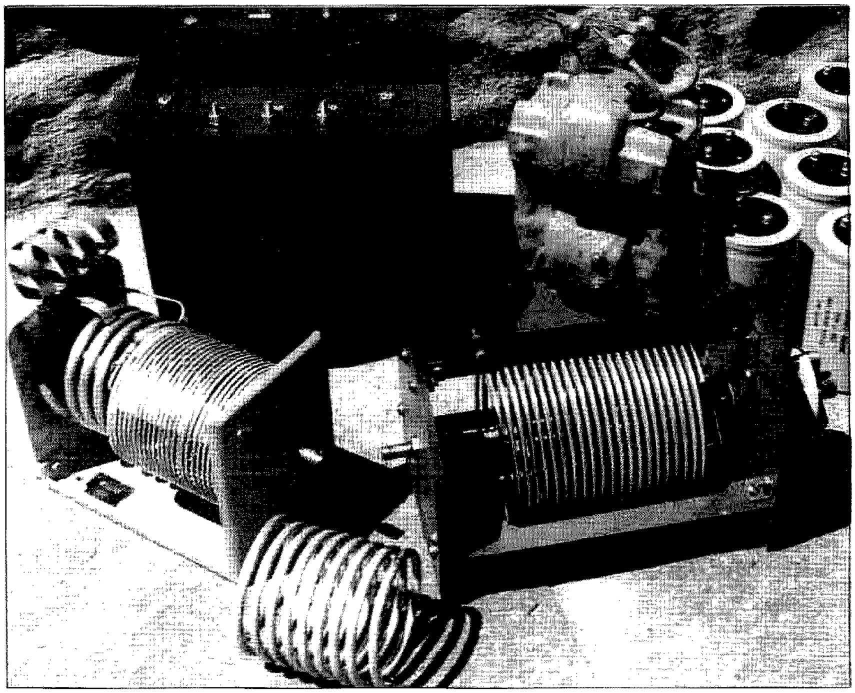


Photo A. *Essential high-power amplifier components. View of an indispensable Peter Dahl high-current plate and filament transformer for top-gun linear amplifiers. Viewing CCW: a bank of 2000 μF @ 450 VDC/500 VDC capacitors; the 10–160m roller inductor; a modified vintage B&W 850 A 10–160m tank circuit/integral switch combination; and a 10–40m coil. All have been silverplated and are ready for assembly.*

Photo B. Silverplating kit (foreground) containing the jars of silverplating gel, copperplating gel for steel (see text), wire, clips, and plating brush. Note the metal "flap" on the top side of the brush that presses the bristles to the work being plated and completes the circuit. In the background is an array of chemical and abrasive cleaning materials, a wire-and-fabric abrasive wheel, emery cloth strips, and the optional Dremel tool for polishing those difficult-to-reach places.

In the quest to break away from the pack, and to stand out above the cacophony of pileup signals, the motivated radio amateur might consider focusing on the amplifier tank circuit to reduce inherent RF losses that may often appear at substantial levels of magnitude at higher radio frequencies. The material to accomplish this task is inexpensive, requires no special skill levels or equipment, and—more important—does not require any equipment disassembly. If it sounds like a win-win situation, read on!

Tank circuit conductor losses

Radio amateurs are well aware that a DC current flowing through a conductor distributes itself uniformly throughout the cross-sectional area of the conductor. As a consequence, the ohmic resistance of the wire is directly proportional to the specific resistance of the conductor (data available from *ARRL Handbook* wire tables) and to its overall length; and inversely proportional to the cross-sectional area.

Simply stated, the heavier the gauge of the wire (using the shortest cabling length possible), the greater the current that can be carried through it with minimal losses. On the other hand, RF current does not behave in this highly predictable manner, and the consequences of subtle power losses, as it moves through a conductor, may have escaped the scrutiny of some radio amateur amplifier builders.

Consequently, in the quest to squeeze out more watts from linear amplifiers, RF characteristics remain a hot topic of discussion. The peculiarities of RF's behavior in linear output networks surface as a vital subject to study and master, and the application of this knowledge for circuit improvement is essential to achieve the ultimate high tech in amplifier design.

What is skin effect?

RF current, because of its distinctive behavior as it passes through a conductor, meets additional levels of resistance because of a phenomenon called *skin effect*. This is a result of alternating current inducing voltages in the center of the conductor that repel the flow of electrons outward towards the conductor's surface. This gathering density of electrons moving on the surface, rather than flowing throughout the inductor, in effect reduces the cross-sectional area through which the current flows. As a consequence, the resistance of the conductor is raised, resulting in increases in heat loss.

Skin effect becomes a more critical factor as frequency is increased. As an interesting note, here's the rationale for making RF tank circuits from copper tubing rather than a solid conductor. There is no need for the more

Relative Resistivity of Metals

Metal	Resistivity Compared to Copper
Brass	3.7 – 4.9
Cadmium	4.4
Chromium	1.8
Copper (annealed)	1.0
Copper (hard drawn)	1.03
Gold	1.4
Iron	5.68
Lead	12.8
Nickel	5.1
Silver	0.94
Steel	7.6 – 12.7
Tin	6.7
Zinc	3.4

Table 1. Relative resistivity of metals, compared to copper.

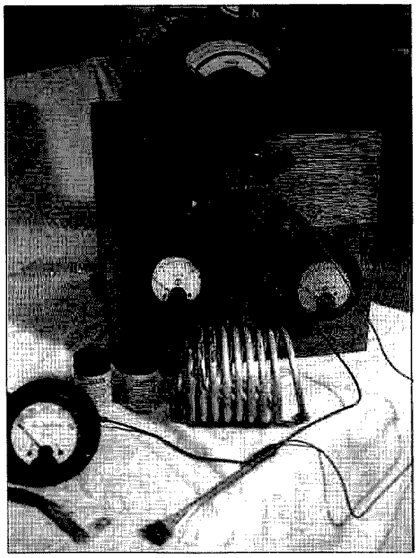


Photo C. Meet "Double Ugly," my circa-1962 variable home-brew supply (like the battery commercial, just keeps going and going). It provided all the required plating current. Hookup wire included with the kit was replaced with longer alligator clip leads to allow for greater movement. The meters at the top and to the left were temporarily added to the circuit. They provided an expanded scale for a more precise monitoring of the voltage and current. The positive lead is clipped directly to the plating brush. The negative lead passes through the 500 mA meter and is then connected directly to the work being plated. If a bench-type supply is not available, the manufacturer suggests using 2 or 3 #6 dry cells in series for 3 to 4-1/2 VDC (see text).

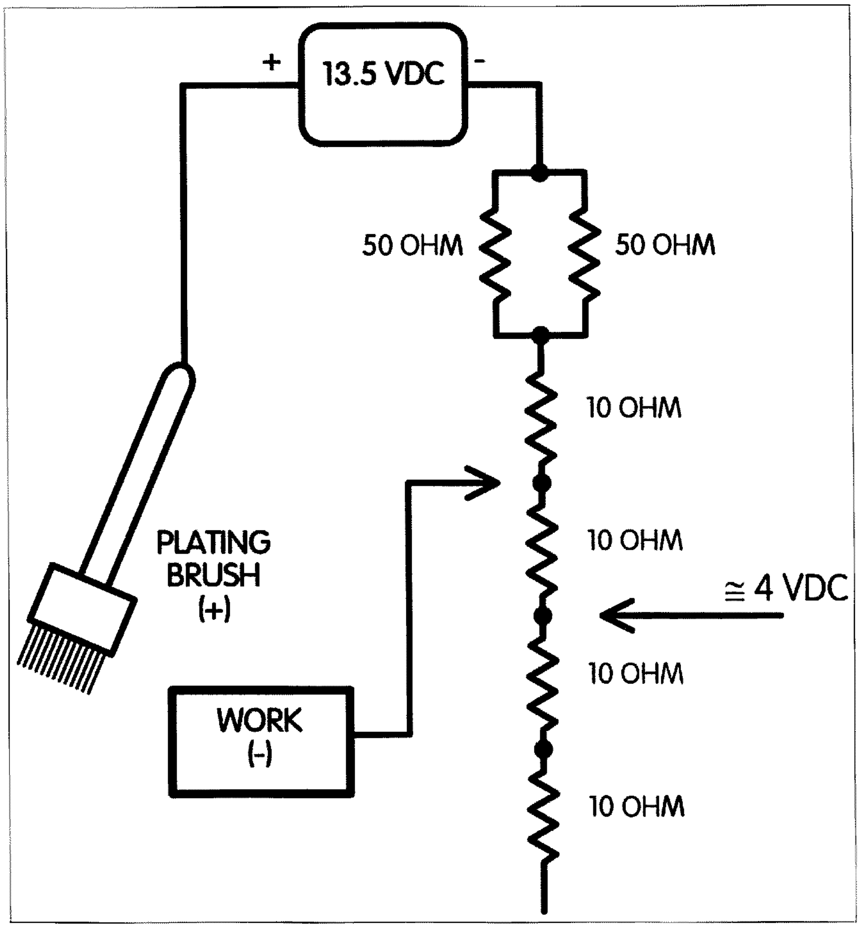


***Fig. 1.** Voltage divider.*

expensive and heavy solid rod simply because it does not conduct RF throughout its cross-sectional mass. As a matter of fact, the RF does not travel to any substantial depth below the surface or skin of the conductor.

With that in mind, take a look at the 10–20 meter portion of your linear amplifier tank circuit to verify the builder's awareness of this concept. If the tubing is not evident in at least this portion of the output network, it's time for a major circuit change. If you find a tank circuit containing virgin copper tubing and heavy 8–10 gauge wire (which will most probably be the case), then be sure you finish reading this article.

The case for silverplating

The *ARRL Handbook* chapter dealing with Electrical Laws and Circuits contains a chart listing the relative resistivity of common metals (including gold), and indicates that only silver has a lower resistance to current flow than copper. (See **Table 1**.) The reference value of "1" applied to annealed copper is lower in silver by 6%. Combine this factor with the unique properties of high-frequency RF flowing on the surface of a conductor and it becomes abundantly evident that the silverplating (over copper) of RF tank tubing or wire is a good investment in time and effort. It may breathe some new life into the old rig (as a result of the diminished ohmic losses) and just may net enough extra power, in the competitive DX world of pileups, to gain for you the exalted top-gun status on the DXCC Honor Roll.

Where to begin?

Any attempt to adapt commercial techniques of silverplating for in-home

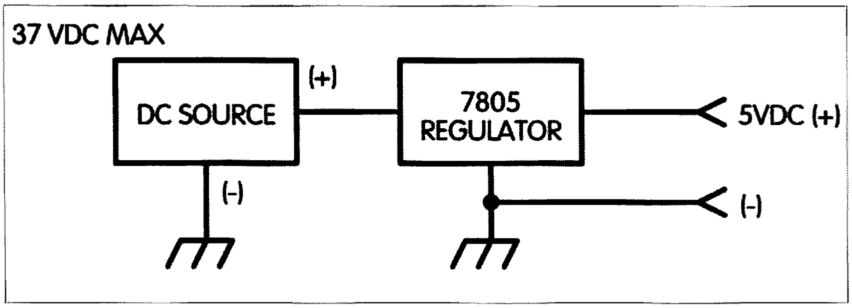


***Fig. 2.** Fixed voltage regulator.*

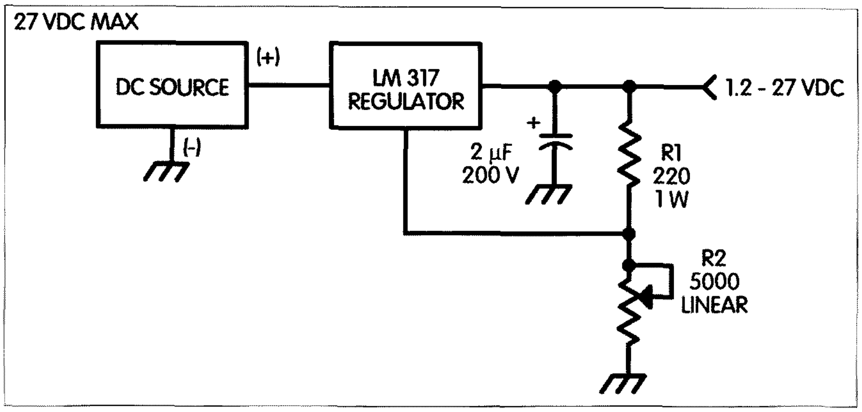


Fig. 3. Variable voltage supply.

use is out of the question primarily because of the complexity of the equipment and the toxicity of the chemical baths. An alternative solution is to purchase a plating kit supplied by a Dallas, Texas, firm that is both inexpensive and uncomplicated to use. All the material, including the chemicals, wire, and clips, is provided as part of the package. All that is needed is a power source rated at 3 to 4-1/2 VDC. The manufacturer recommends two #6 dry cells connected in series (3 VDC) for general plating work. In certain instances, you can simply wire up an additional battery to the string (4-1/2 VDC) for speedier plating on larger areas.

In my case, I used my circa-1962 "Double Ugly" bench variable supply (see **Photo C**). With its output adjusted for about 4 VDC, the process ran flawlessly. Current draw was about 200 mA. The dry cells are OK, but they are expensive and really have no practical value after completing the plating process.

The best deal is to use a bench-type (Astron or equivalent) 13.5 VDC supply, or to connect up to your automobile battery. Use the voltage divider circuit depicted in **Fig. 1** to get the power level you need. Another alternative is to use a fixed voltage regulator (5 VDC) and power from a variety of DC sources (**Fig. 2**). There's always a power cube around from one of the video games, or check the battery pack on your HT or power screwdriver as a potential and renewable (rechargeable) power source. You may also consider a variable voltage regulator (**Fig. 3**) along with any one of the power sources suggested. This inexpensive setup will conservatively provide voltages from 1.2–27 VDC at 1.5 A, and it can have a practical value for a variety of other projects down the line.

What's the trick in silverplating?

Heed the manufacturer's admonition that "plating can only be as good as the surface on which (it's) applied." In the plating of any metal, preparation is easily 95% of the task.

Begin the process by gathering up some brass/copper chemical cleaner, 400-grit emery paper, steel wool, and a supply of stiff-bristled toothbrushes. All of these can be located at the local home center at minimal cost. In addition, you'll need a supply of soft rags (old T-shirts are perfect), a handful of cotton swabs, and possibly a Dremel™ tool fitted with a couple of polishing discs to help get into the tight spots.

Our purpose is not to polish to a mirrored finish. All that is required to prepare for a clean plating surface, with good bonding characteristics, is to thoroughly remove all the copper oxidation. If the surfaces are flat, use the steel wool or 400-grit emery paper. For large areas, use a wire wheel. In tight spots, the chemical cleaner and toothbrush or swab are indispensable.

Make certain there is adequate ventilation in the work area. The best idea is to use the chemical cleaner outdoors, especially if you anticipate it may take some time to complete the cleaning.

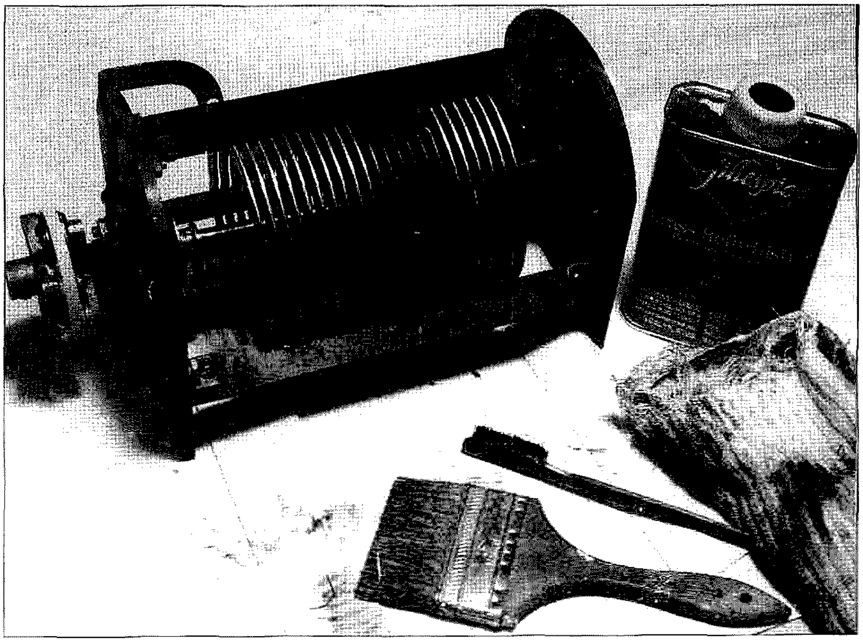


Photo D. *Because of the difficulty of getting into hard-to-reach areas, a chemical cleaner was used to remove years of oxidation from the super-heavy-duty roller inductor. Note that the six center coil bands have not been cleaned to illustrate the contrast. The chemical was liberally brushed onto the metal. The process is similar to chemical paint stripping. A toothbrush assisted in getting to those hard-to-reach spots. A soft rag (lower right) was essential for removing any residue. The work area must be well ventilated. Working outdoors is highly recommended.*

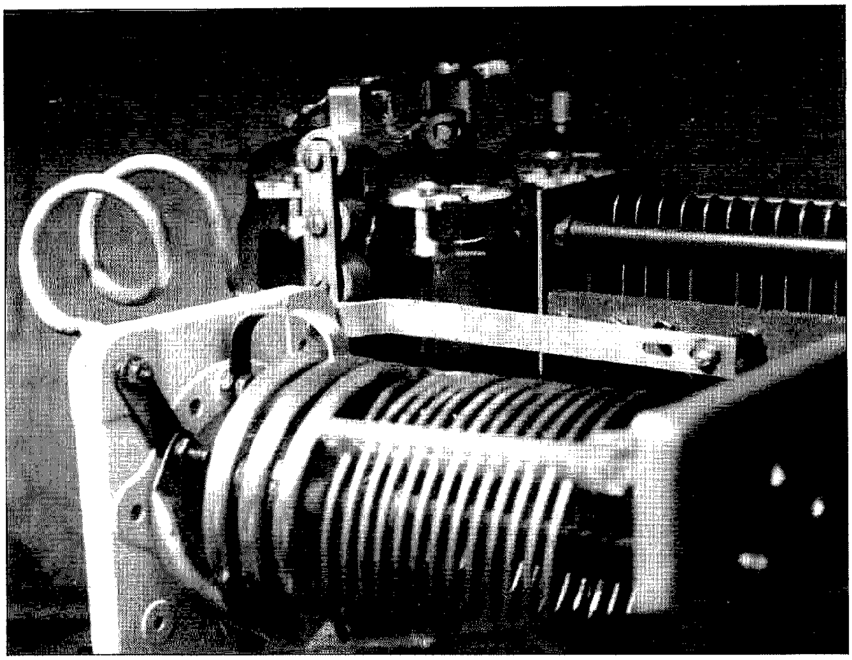


Photo E. View of a modified "three-hole" 813 linear amp. All the coils, flat copper stock, and flexible coax shielding to the tubes and the air-variable plate-tune capacitor have been silverplated.

Preparing the rotary inductor (see **Photo D**) for plating was indeed tedious and time-consuming. The work seemed endless and the cleaning progressed slowly, simply because many of the surfaces were difficult to reach. I took the operation outdoors and placed it on newspapers to protect the table from the chemical cleaner. However, the final product was worth the effort and will prove to be one of the vital links in the assembly of a state-of-the-art linear amplifier.

The final step

When you think you've done a yeoman's job on the preparation aspect of the task, go over it again to doubly ensure a clean, residue-free surface. Silver will not bond to an ill-prepared base! You will find that it's extremely difficult to overcome the urge to get going with the plating, but that aspect of the process will come soon enough.

The plating may even seem anticlimactic, since the actual silver application is quite simple and straightforward. It's often completed in a very short time—especially if the component parts are small with little surface area. Use the wire and alligator clips supplied to connect the batteries' minus (-) terminal to one end of the surface to be plated and plus (+) terminal to the brush supplied in the kit.

If the bench power supply you're using is not metered, wire up your VOM or a spare 0–500 mA meter in series with the negative leg to monitor current draw. I preferred using long jumpers with clips at both ends for some extra working length convenience.

I recommend that you make certain there is an adequate supply of fresh air when you plate. If you have a variable supply, adjust the voltage to about 3–4 VDC and dip the brush into the jelly-like compound, making certain that both the bristles and the underside of the anode are continually well-covered with plating material. If your meter indicates an increase in current flow after some plating, it's time to pick up some additional gel from the jar.

It might be a good idea to test your setup and perfect a rhythm utilizing a piece of scrap copper. Use short circular motions with the anode, firmly pressing the bristles to the work. Usually 20–30 seconds over an area will be sufficient to deposit a layer of silver. At regular intervals, renew the supply of plating material by dipping into the chemical container. For

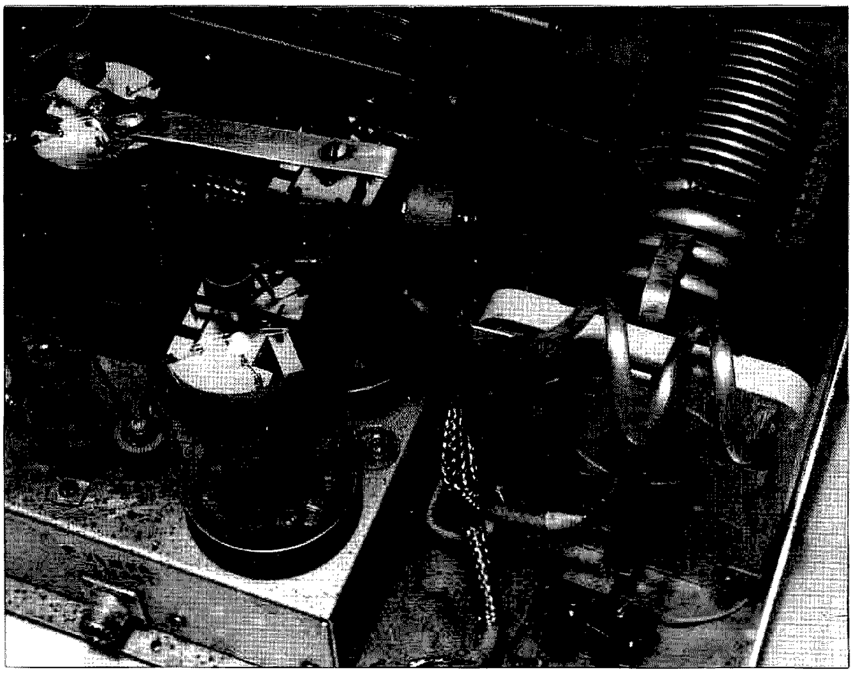


Photo F. This view of the 813 amplifier shows several silverplated components. The 850-A tank circuit and the 10 meter coil have both been plated. The flat stock connecting the vertical HV plate choke to the three "doorknob" capacitors, and the stock connecting the other side of the capacitors to the tank circuit have been silvered as well.

Photo G. The heavy copper strapping from the 4-1000 A plate cap, the plate parasitic choke, door knob supports, and the 8U coax shielding, which directs RF to the tank circuit and plate-tune vacuum variable, have all been dressed in a new coat of silver.

heavier plating, slow down the circular motion process to allow more time for the metal to transfer. You may even try experimenting with slightly increased voltages (6–8 VDC) to improve the metal transfer.

When you're done, rinse the surfaces with water or use a soft cloth to wipe the work clean. If there are areas that did not accept the silver because you missed a spot during preparation, don't be alarmed. Lightly polish the spot with the emery paper or steel wool and replate over those sections. Wipe the work area clean.

Use a little household silver polish to brighten up the silver finish and step back to take a good look at your project. You'll marvel at how well the system works and how much compound remains for other plating tasks. Incidentally, the supplier provides a bottle of copper undercoat in the kit if it's necessary to silverplate over steel (nuts, bolts, washers, etc.). When you're through, clean all the implements with water and dry thoroughly.

What else can I plate?

The manufacturer, in addition to providing a silverplating kit, also offers a package of materials to plate both gold and nickel. If you've experienced oxidized contacts with plugs and sockets, you may consider their 24-karat goldplating kit for use in this problem area. Gold is a bit more expensive than silver, but a jar of material should last a long time. Whatever you do, avoid the temptation to plate your tank circuits in gold. The metal resistivity chart should dissuade you from that idea, since ohmic losses for gold are greater than those for copper. It will most certainly look great, but that's about as far as it goes!

A final comment

Keep in mind that everything you do to finesse your electronic circuits results in an increase in radiated power. Perhaps someone may say the theoretical power increase due to the slightly lower ohmic resistance of silver is not worth the time and effort for this undertaking. In response, remember that the boys in the DX pack are very much neck-and-neck in their quest for that new and elusive country and whatever you can do to squeeze out even a couple of watts of power may be all that is necessary to make the difference in the pileup. Give it a try. You'll find it an interesting project. Success to you in both your plating and DXing endeavors ...

A silverplating kit, $16.50 ppd., goldplating kit, $39.00 ppd., and a combination gold/silver kit, $48.50 ppd., are available from:

Texas Platers Supply
2453 W. Five Mile Pkwy.
Dallas TX 75223
(214) 330-7168

For custom transformers/amplifier components, send for a brochure from:

Peter W. Dahl Co. Inc.
5869 Waycross Ave.
El Paso TX 79924
(915) 751-2300

Wanted!

Stories about all the fun you've been having with Amateur Radio, for possible publication. Write to Joyce Sawtelle at 70 Route 202 North, Peterborough, NH 03458.

Build Your First Kit!

Just follow one ham's simple advice ...

Peter A. Bergman NØBLX
517 Estate Dr. SW
Brainerd MN 56401

I have often heard old-timers say that kits aren't available anymore, and I've heard newcomers say they'd like to build a particle wave modulator or something of equal complexity. To the first I say, "Excuse me!?" There are a number of great kits available. To the newcomers, I say, "Great!"—but let's start with something a little simpler, like Ten-Tec's T-Kit 1001 Broadband RF Preamp.

I have had pleasant experiences with T-Kits in the past, so when I wanted a broadband RF preamplifier I decided to order their No. 1001. I was looking for something simple to assemble and easy to use for demonstration purposes. I also wanted to see if I could squeeze a couple more TV channels out of the rabbit ears. The 1001 is an excellent example of a kit for the beginner. It's something you can put together, get working, and use before you start on the kit you bought with the car payment money.

In previous articles I have recounted the joys of kit building as one of the many facets of the amateur radio hobby. I recall hearing it claimed, once upon a time, that kit building provided nothing but soldering practice. It probably was not entirely true then and certainly is not true of the modern breed of kits. Ten-Tec has been producing quality ham gear for a long time and now its T-Kit division is providing products for those who want more hands-on experience.

Before saying any more about the 1001 kit, let's review a little basic electronics. In electronics classes, the "water analogy" is often used. Resistors are compared to flow restrictors, while capacitors and inductors are compared to storage tanks and filters. A similar analogy can be made for amplifying devices, either tube or solid state.

If you think of an amplifier as a valve, then the handle can be compared to the

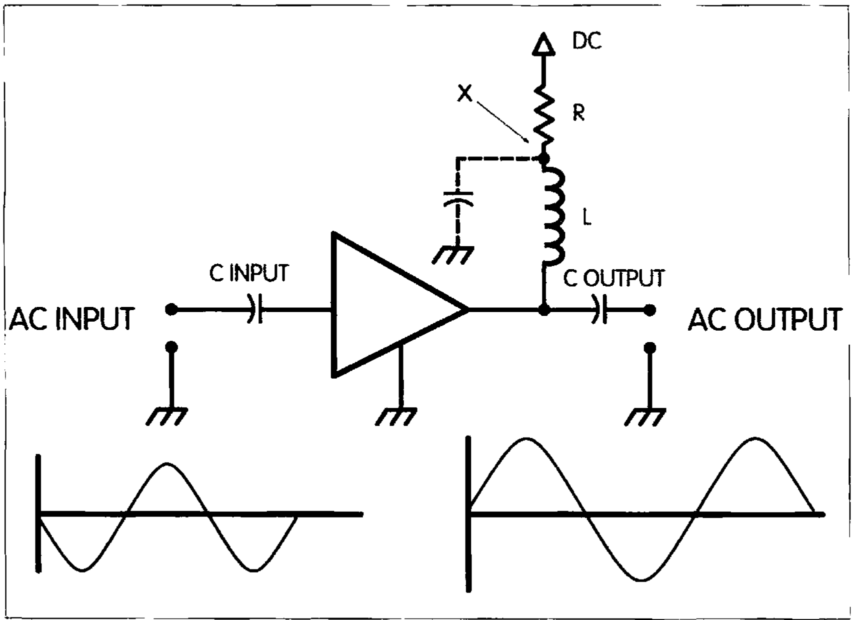


Fig. 1. Schematic of a simple amplifier circuit.

input signal and the fluid to the supply voltage. A relatively small input at the handle can control the flow of a large amount of fluid from the supply to the output.

The triangle in the center of **Fig. 1** is the standard symbol for an amplifier. It doesn't matter if it's a bipolar transistor, MOSFET, tube, or whatever. In a diagram this simple it is easy to follow "conventional" practice and show input from the left, output to the right, and operating voltage in at the top.

Capacitors pass AC and block DC, so we want one on the input line. It will allow our AC signal from the previous stage or device to pass through to the amplifying device. It will also keep any DC at the input from getting through—in either direction. At the output we want the same thing to happen so we install another capacitor there. These are called blocking or coupling capacitors, depending on how you look at it.

We want our amplified signal to go to the next stage or device, where it can do some work for us. We do not want it to go to the power supply, where it could cause problems. Inductors pass DC and block AC—just the opposite of capacitors—so we'll install an inductor in the operating voltage line. If we were still concerned about the signal getting into the power line and from there into successive stages, we could install another capacitor between point "**X**" and ground.

The resistor in the DC line gives us a bit of control over the amount of voltage applied to the amplifier. We could install a variable resistor there which would give us a gain control, if we needed it. This bias resistor also helps provide current and temperature stability.

Notice that as the input goes positive, the output goes negative. In many applications that's OK, but if we need to have the output in phase with the input we can add another amplifier stage. This will re-invert the signal so it matches the original. We could even build a gainless stage so the signal inversion would occur while retaining the original amplitude.

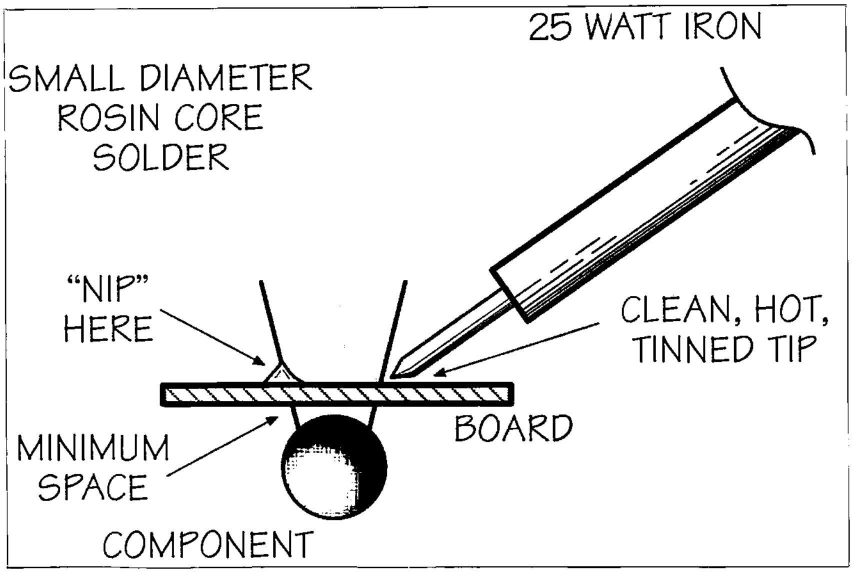


Fig. 2. *Note that the joint must be smooth, shiny, and slightly concave.*

Although inverted, the output has the same waveshape as the input. Or, rather, it is supposed to. In any high-gain device like the T-Kit 1001 very little drive signal is required. If a good strong signal is already present, adding amplification can also add distortion by overdriving the preamplifier or the following stage.

Now that we've dealt with some basic theory, let's take a look at soldering technique. See **Fig. 2.** This is the area that probably contributes the most to kit failure. It is not hard to learn how to do it right, but it does take a bit of practice. That is why I recommend starting with a simple kit like the 1001.

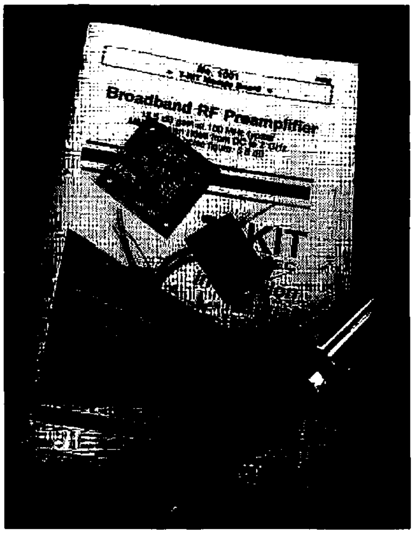


Photo A. *Ten-Tec's T-Kit 1001.*

First off, the board and all the components must be free of grease and corrosion. Second, you want to use appropriate tools and materials. Buying a kit pretty much takes care of the first item, so all you have to do is keep your hands clean and free of grease. Also, remember that solder contains lead, which is toxic, so eating or smoking while you are soldering is *not* recommended. You were wanting to cut back anyway, right?

Since you don't need a large assortment of tools to get started in kit building, buy the best you can afford. For this project you will need a small pair of diagonal cutters, a pair of needlenose pliers, an adjustable wire stripper, and a 15- to 35-watt soldering pencil. If the pencil you get has a replaceable tip, make sure you never screw it in much more than finger tight. Then make sure you loosen the tip at the end of your building session. That way it won't be seized into the heating element when it needs to be replaced. Some folks even recommend coating the threads with powdered graphite to help conduct heat and avoid seizing.

When doing electronics work, never use anything but rosin-core solder. No one is going to have any sympathy for you if you use something else. For board assembly use small-diameter solder. I've known people who use smaller stuff but .030-inch works for me. If you use larger diameter solder you're going to find it hard to keep from getting too much on the joint. The possibility of creating solder bridges increases rapidly.

These bridges—shorts—create random power and signal paths that the designer never intended. The other soldering problem is the cold solder joint. Any joint that is not bright, smooth, and shiny is suspect, but can usually be corrected by reheating. The problem with cold solder joints comes from the fact that they may work *now*, but will not stand the test of time. Sooner or later, they lose conductivity and become open.

That's enough of the basics to get us started, so let's take a look at the 1001 preamp. This preamp is based on the Hewlett Packard MSA-0104 "Modamp." It has a 3 dB bandwidth of DC to 0.8 gigahertz, with a typical gain of 17 dB at 0.5 gigahertz. The kit is small enough that it can be built into many existing receivers. Its rated current draw is only 40 milliamps so power could be "borrowed" from the parent device easily.

The instruction manual meets T-Kit's usual high standard. Besides telling you what the device is and how to assemble it, there is enough theory and application information to help you go "beyond the device."

The T-Kit 1001 can be used as an IF or RF gain block in an original receiver design or added to an existing receiver. Assembly of the 1001 is so simple that it will give you an opportunity to spend time experimenting with applications. Because of its tremendous bandwidth, the 1001 can be used to increase the sensitivity of a very wide variety of receivers: public service scanners, SWL receivers, VHF/UHF monitors, TVs, you name it.

If you want to get your feet wet in kit building, this is a good place to start. 73 and have a ball!

Limited Space Antenna

Short of real estate? This might help!

Francis Y. Kelson HL9BK/K2KSY
PSC 450, Box 0826
APO AP 96206-0826

With the coming of the summer doldrums, and band conditions being what they are, I found the need to expand my area of operations to another, primarily 80 meters. At the same time, I didn't want to lose the capability that I already had on 20 meters. It is a very good band from this part of the world, but with more activity for us during the daylight hours than the evening.

After dusk 80 meters showed an excellent potential for sporadic DX as compared to 40 meters, which is congested, to say the least, making my QRP operations virtually impossible.

What to do? The size of my roof only permits me the basic real estate necessary for a 20-meter dipole antenna—the noise element being a major factor, a vertical was out. So, with that in mind, I finally resolved my problem with the use of loading coils, in the same manner that is used with verticals.

Cramped for space? This little gem will surprise you. It's a dipole that is resonant at 3.5 MHz and 14 MHz, with the capability of being used on all bands from 3.5 MHz through 50 MHz with the aid of an ATU.

L2 and L3, the 3.5 MHz stubs, may be placed in almost any position.

You should note that **Fig. 1** shows a typical installation convenient at the time. Other configurations are certainly possible.

The T-bars were used for a now-vacant clothesline, and gave a tilt benefit through which the direction of fire is accomplished. An added bonus is that extending the length of L2 to 18 feet, 8-1/2 inches, and joining it with the end tip of L3 provides a loop that is flat on 14 MHz. A radical approach to loop configurations—an asymmetrical triangle?

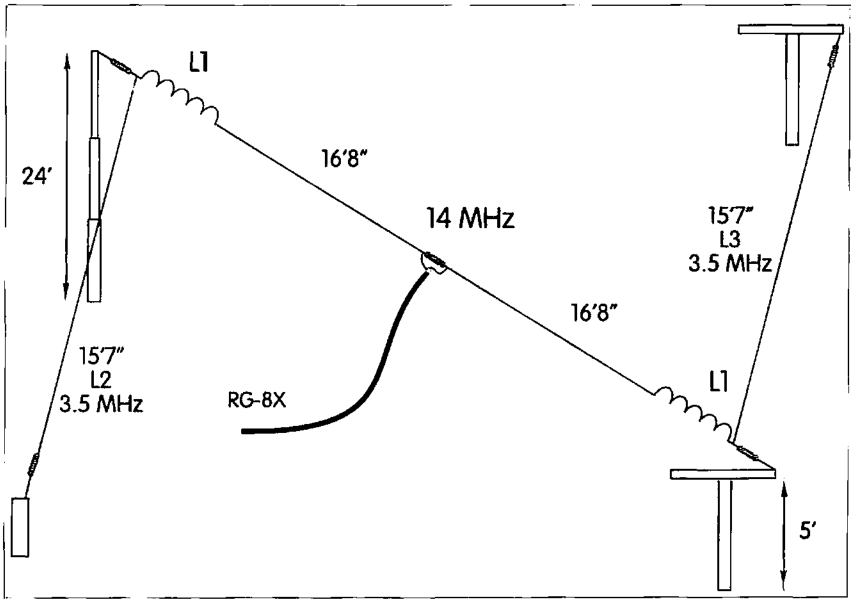


***Fig. 1.** One possible orientation of the limited space antenna.*

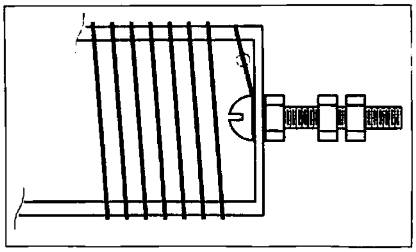


Fig. 2. *A small machine screw-and-nut assembly provides coil strain relief.*

This antenna will also tune with the aid of an ATU from 3.5 MHz through 50 MHz. L2 could be attached with a quick disconnect. When not needed, the wire simply is balled up at the 15 feet, 7 inches mark and tied off. Nope! You don't need to cut the wire to maintain a resonant condition. Just ball it up tightly, and tie it off as a dipole.

Coil construction

The construction of both coils is straightforward. They were wound on plastic pill bottles that have a diameter of 11/16 inch. The coils are closewound for a length of two inches, or 85 turns.

Referring to **Fig. 2**, you will note that screws were placed at each end. This was done to reduce any strain on the coils' windings. You can use any type of nonconductive form as long as the diameter requirements are met. A good coat of shellac is recommended as protection against the elements.

Note that the L1 coils were designed for light weight and QRP operation. A quick test with Ken WH6CQH on the big island of Hawaii using the antenna in the dipole configuration revealed that the coils can sustain a power level of 50 watts. By the way, Ken was involved with a pileup from Europe, NA, and SA, and he gave me a "five by three" off the side of his beam, indicating that the wire is radiating. A further test in the loop configuration with Mario IK2IQP in Trieste, Italy, provided me with a five-nine and we held it for 25 minutes. 7J4ACS, Far East NCS, gave me a five-nine from the back of his beam, and the coils didn't even get warm, So it's back to four watts QRP, hi, with plenty of overkill.

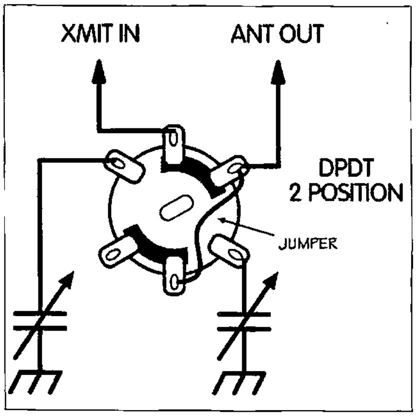


Fig. 3. *A ceramic wafer switch allows the ATU to be easily bypassed.*

Tips

My ATU is a Ten-Tec 291. It has an excellent range and has been modified so that it can be switched out of the line. This is ideal for antenna experimentation, and for checking line resonance. As noted in **Fig. 3**, a good-quality ceramic wafer switch is recommended. A recent test with some commercial ATUs revealed that if, say, 20 watts were introduced, and an ideal SWR, and power out indication were observed, you may find that only about 200 milliwatts is actually leaving the ATU. They make excellent dummy loads.

I also use an MFJ SWR analyzer both for checking line resonance and for ATU adjustments to prevent interference. I have a simple home-brew switching unit to kick in the analyzer, but many good quality commercial units are available. You have to ensure that the loss is not more than 0.2 dB and that isolation is at least 60 dB to prevent damage to the analyzer.

As an afterthought, I was wondering what would happen if the RG-8 coax was replaced with 300-ohm line. If you try this, would you please drop me a line? Keep 'em resonant, folks.

30 feet #24 enamel wire
2 plastic pill bottles, 1-1/16" diameter
85 feet speaker wire
RG-8/X mini coax, any length

Table 1. *Parts list.*

How To Build A Great Ham Club

Good advice from the PR master.

Wayne Green W2NSD/1
c/o *73 Amateur Radio Today*
70 Route 202 North
Peterborough NH 03458

When ham club meeting night comes along, do you have a problem with priorities? Should you go to the club meeting or to the dentist? Or perhaps a visit to your mother-in-law? Tough decision. The answer is to get the heck down to the club meeting and get the club off its collective ass. You can make the club so much fun the members will be fighting to have weekly meetings instead of monthly. Now stop sitting there wringing your hands, hoping someone else will do it.

Yes, I do a lot of things. You know why? Well, every time I look around and say to myself, gee, someone really should do something about so and so ... I realize that, heck, *I'm* someone. So I go ahead and do it. It's amazing how much you can get done when you decide to do it. Isn't it time you started making some decisions which will add to *your* life?

Show biz

Okay, let's apply that concept to getting your ham club going like gangbusters. I said to stop wringing your hands—let's get to work on this. The first thing you have to understand about ham clubs ... about any clubs ... is that you're in show business. It's basic—if the members don't have fun they aren't going to come back. Think about it.

What's fun to do at radio club meetings? One fun thing is to get to talk with your fellow hams. Have you built that part into your club meeting? Give 'em some refreshments about halfway through the meeting and maybe twenty minutes to chew the rag. Coffee and assorted doughnuts are good fare ... or fresh cider and doughnuts. Have you someone in the club who can make a homemade coffeecake?

A meeting can be made fun if you can find a good speaker. Is there a ham manufacturer or dealer within reasonable commuting distance of your club? Ask him or her to come in to show and tell the members about his product.

A hint on the care and feeding of speakers ... take care of them and feed them. Get maybe three or four members of the club to have dinner with the speaker before the meeting. Pay for dinner, you tightwads. If you're driving your speaker to the meeting from the restaurant, you might have a two-meter rig in the car with the members talking up the meeting over the repeater. This will give the impression that you have a live group.

Once you're at the meeting place be sure that many of the members come up to the speaker and introduce themselves—perhaps with some compliments on his product. Get off to a good positive start. I hate to think of how many club meetings I've been to where the members all were busy talking with each other and ignored me completely. If you want your speaker to be interesting he has to be the star for the evening. Get him on early. Take the time to give him a good introduction. Give him any help he needs to demonstrate his product.

Start the meeting on time. How do you get the slow arrivers to stop straggling in late? Hold the door prize drawing first instead of last. A couple times missing the drawing and you'll find 'em remarkably punctual.

If you really must have a business meeting, keep it to under ten minutes. You should do this anyway, for nothing kills a club like extended business meetings. No good can come of it. Let the executive committee handle the business and give the club a fast report.

If you've a shortage of ham industry people in your area you should look around for ham fanatics to show and tell. Check out your members for any known DXers, packeteers, SSTVers, RTTYers, moonbouncers, meteor scatterers, microwavers, OSCARers, certificators, contesters, builders, traffic handlers, and so on. Lift up the local rocks and see what wiggles.

I've seen some great DXpedition slides, and heard interesting talks on just about every ham fetish. They're out there if you'll beat the bushes. And don't dump the problem on the program chairman ... get the whole club to scrounge.

Can you get some Novices and Techs to come to the meeting half an hour early for a short technical talk and perhaps ten minutes of code practice? This is a good way to help newcomers get licensed—and club members move up the ladder more easily. The club has to be fun ... but it should also be supportive of the members. The club is where you provide the peer pressure to get 'em to get a higher class ticket. It's where you get more and more members to try new aspects of the hobby.

Keep 'em short

Now, after the speaker and the Q&A ... and then after the feeding frenzy ... it's time for some reports. Short reports. This is the time for the TVI committee to report on its activities ... the licensing committee on new and upgraded licenses ... the school radio club Elmering committee ... the self-policing committee on recent complaints ... the program committee on upcoming entertainment ... news of club activities such as an auction, flea market, picnic, mountain-topping party, Field Day effort, and so on. How about organizing groups to drive in a caravan to major hamfests and conventions?

At least one club member must be a desktop publishing whiz by now. Quickly, elect her/him editor of the club newsletter. Help him set up the reports he's going to need and the deadlines for the reports. You want to build interest in ham activities so get in reports on packet action, DXing scores, contest scores, antenna erecting parties, OSCAR contacts, and so on.

Does anyone in your club have a video camera? Great! Get him/her to do a video of the club activities. Get her to visit members and make a video of their stations. If the club has some fox hunts you can make a fun video of the hunters. If you don't have fox hunts, why not? A short video will brighten up a meeting. If you don't have someone in your club with a camcorder and another member who's into desktop publishing, you're badly in need of some new blood.

Growth mode

How can you get new members? Easy ... the club newsletter is a good sales tool. Get someone with a computer to make a list of every ham in the *Callbook* in your zip code areas and start sending them the newsletter for perhaps four issues with an invitation to come to the next meeting. You might even tell them what fun they will have when they come. Remember, as I said, you're in show business now. Once you get them to their first meeting, be sure you have a committee to spot them and make a fuss over them. Introduce them during the meeting. Make them special and they'll be back.

You can't afford to send free newsletters to a zillion inactive hams, so rotate the free copies as you can afford. It wouldn't hurt to have club members take lists of the potential members and give them a call with a personal invitation to come to a meeting.

At meetings you can ask members to make a list of every ham they hear in the area who should be invited. This will help you pick up many which aren't listed in the *Callbook* yet. It'll give you a first-class mailing list, too. These folks are active hams, so they'll probably be an easier sell than someone who hasn't turned on a rig in ten years. Make sure club members talk up the club on the air and invite everyone they talk with on the air to the next meeting.

Be sure to put a small poster in any local ham dealer store. You'll want to have posters in the local high schools, too. Your newspapers will list your meetings, complete with a short story on your speaker. Cut out a copy for the speaker and give it to him. It'll help his ego.

Does your neighborhood have any bulletin boards? Get your posters up there, too. How do you make posters? Somebody with a computer will be happy to oblige.

Have you thought about organizing some club outings? You might get a group together to visit a TV station ... an observatory ... an electronics plant ... an FAA station ... a research lab. You'll probably find at least one member with an "in" for such a visit.

Now get going

Okay, I've primed the pump ... now I expect you to fill the pail. If you have any ideas on how to get clubs perking, send them in so I can pass your ideas along ... and give your club some credit.

Oops, I almost forgot. If I'm speaking at a club I ask for no smoking ... and generally get a round of applause for it. Why not ask your nicotine addicts to indulge in their drug habit outside? Nicotine is a poisonous oily substance gotten from tobacco leaves ... named after Nicot, a French diplomat who introduced the drug to France.

I've run into a few clubs who encourage the use of alcohol, passing around cans of cold beer—another drug with millions of addicts. Let's keep drugs out of club meetings ... alcohol, nicotine, pot, and cocaine. Phooey ... none of these drugs is going to improve your meetings.

Adapted from 73 Amateur Radio, *July 1986.*

Electronic Construction from A to Z, Part 2

Everything you wanted to know about building stuff—but were afraid to ask.

Marshall G. Emm N1FN/VK5FN
2460 S. Moline Way
Aurora CO 80014
[n1fn@mtechnologies.com]

Last month we talked about tools and basic construction techniques: now it's time to use what we have learned. We're going to build an AC voltage monitor, which uses colored LEDs to display a range of voltages. Electronically, it's pretty simple—a plug-pack transformer supplies DC voltage (which varies with the AC line voltage it's plugged into) to a pair of quad op amps. The op amps are configured for voltage comparison, and turn an LED on if the voltage is equal to or greater than a specified voltage. Seven LEDs are set for levels of 100, 105, 111, 118, 123, 128 and 132 volts AC, with a bar-graph effect: All LEDs below the measured voltage will be lit, and they are color-coded (two red, two yellow, and three green) so you can tell at a glance if the main voltage is within normal limits. For future reference, there is a similar kit available to monitor DC voltage on a 5, 8 or 12 V supply. You could put both units in one box for a complete station power monitor.

Everything you need to build the VM-110 is in this article: the schematic, parts list, parts overlay, and circuit board artwork (reprinted with permission), or you can buy a complete kit from Milestone Technologies or Electronic Rainbow.

Why this particular kit? It's useful, you probably don't have one already, it's reasonably inexpensive, and it is of moderate difficulty. You'll be working with polarized components and integrated circuits, and along the way you'll have to overcome some challenges. A Rainbow Kit also conforms to my Rule #1 for kit selection: Never buy a kit from someone who won't fix it if you can't get it to work! You will usually have to pay a repair fee, but at least you know you won't be throwing your money away. And such a service is an indication that the kit seller has done everything possible to make the kit buildable.

While it might look like it at first glance, this is not a "project article" as such. Its purpose is to help you learn to build any project, not just this particular kit. Along the way we'll talk about things that aren't even related to this kit, and that's why it will take so much print space—when the actual instructions you would get with this kit are printed on a single side of a letter-sized page! Besides, the topic is really huge. We're talking mechanical skills, manual skills, a considerable amount of knowledge, and, of course, experience. Experience is something you can only get for yourself, but you have to start somewhere. The intention here is to keep it as simple as possible, but give you a base to build on.

Step One: Read the instructions

All of them! Even if it's a 30-page booklet, you really need to read through it to get an idea of how to proceed with construction, whether you will need to make any "option" decisions, whether the order of construction is mandatory, etc. And often you will find explanations for little mysteries, like extra parts or unusual parts that you might encounter in Step Two.

There are tremendous variations in the standards of documentation for kits. Sometimes you will be told in excruciating detail exactly what to do, and sometimes the instructions will be very general. Here are a couple of actual examples from kits I've built recently, word for word:

Excruciating Detail: "... 52a. Locate resistor R1 (1 k, Brown-Black-Red). Bend the leads and insert on the

component side of the board in the space marked 'R1' which is near the transformer you installed in step 48. Solder and trim leads."

The "No Instruction" Instruction: "Insert and solder all of the board-mounted components."

On with the show

Rainbow's Assembly Instructions for the VM-110

Place all the parts on the Fiberglas™ side of the board and solder on the metal side.
1. Insert and solder all resistors.
2. Insert and solder D8, D9, D10, U1, and U2 (watch polarity).
3. Insert and solder R16 trimpot.
4. Insert and solder the LEDs and jump (watch polarity of LEDs).
5. Connect the wall transformer to your completed PC board. The solid wire is the "– input" and the wire with the white line is the "+ input."
Very carefully check all of your work before you apply power to your kit. To properly calibrate your kit, you must be able to monitor and adjust the incoming AC. Set your voltage to 118 VAC and connect your wall transformer. Adjust R16 until the #1, #2, #3, and #4 LEDs are "on." Check operation by varying the input voltage, and checking the voltage against the voltages given at the beginning of the article.
By adjusting R16 you can set the center LED to light from 111 to 123 VAC. You can also select a different color sequence for the LEDs, to better suit your situation.

The instructions for the VM-110 kit are about 80% of the way toward the "no instructions" end of the spectrum. That's good, because extremes are generally bad. In the excruciating detail approach it is assumed that you will follow the instructions step by step, and it's very difficult to change the order of construction even if you have good reasons for doing so. And such instructions are hard to maintain when the kit manufacturer makes a minor change—a lot of instructions have to be changed and they often miss one or two.

Sometimes you will have to make decisions as you build the kit, so it's a good idea to work your way through the choices before you start. Sometimes there are actual options, as, for example, a transceiver kit where you can select either fixed or variable IF filter bandwidth. The VM-1 DC voltage monitor lets you choose which base voltage to measure (5, 8, or 12 V) and what the steps should be for each LED (.25, .5, or 1 V steps). These options often have parts implications, so that's another reason for reading the manual before counting the parts.

There can also be "user modifications," or cases where you might want to do something different from the literal instructions. That's one of the great things about kit building—it's your kit and you can do anything you want with it! An example of this might be where a board-mounted pot is supplied and you would rather wire up an external pot on a control panel. Again, it helps to have these things in mind before you start building.

Step Two: Taking inventory

If you are gathering the components yourself this is not an issue, but if you have bought a kit it is important to find out right away if you got everything you paid for. Locate the parts list (**Table 1**) and inventory the supplied components. Check the values carefully, and check them off on the parts list as you go. In my experience wrong or missing parts are something of a rarity but it does happen, and reputable kit suppliers will fix the problem fast. In fact, if you start by checking the parts you will often be able to obtain a replacement before you actually need the part, especially with larger projects.

Usually there are only two problem areas in checking component values: resistors and caps. Resistors because there are often a lot of them and the value is indicated by colored bands, caps because there are often lots of them, too, with multiple standards for labeling, and frequently you will need a magnifying glass to read the lettering. A complete rundown on component identification would take more space than the editor will let me have, so I'll refer you to the *ARRL Handbook*. You should learn the resistor color code, so I've provided it for you in **Table 2**.

Don't hesitate to use the process of elimination when you must. If you can't absolutely identify the nature or value of a component, go on and do the rest of them and see what's left. Often it helps to look at the quantity of a component, too. For example, you might be working on a kit (not the VM-110) that has .01 and .001 μF capacitors which you can't tell apart, but since there are supposed to be two of the former and 15 of the latter you should be able to figure it out.

Sometimes you will find extra parts, and parts which are not listed on the parts list—case in point, the VM-110 I built while developing this article had an extra set (seven) of 1 k resistors. I've done kitting myself, and with inexpensive components like resistors it is occasionally easier to throw in extras "to make sure" than to re-count everything. Also in my VM-110 kit the plug-pack transformer was not listed on the parts list, nor were sockets for the integrated circuit chips.

You can test, or measure the value, of many components as you go. Until you have a lot of experience working with resistors, use your multimeter to confirm the value that you have deduced from the color code. Your multimeter will also tell you whether a diode is good (and confirm that it is, in fact, a diode), and some of the more elaborate multimeters will measure capacitance and inductance and even test transistors. Actual testing of components is generally a waste of time with commercial kits, but don't overlook it as a means of identifying parts.

As a more or less last resort (it's tedious work) you can cross-check the parts against the circuit diagram. And if all else fails, don't hesitate to get in touch with the kit supplier. Most of them are happy to clarify things for you and—even happier to find out where there are problems in the documentation.

About printed circuit boards ...

Printed circuit boards (PCBs or just "boards") come in a wide variety of types, colors, and materials. Every board

Parts List		
Part	**Description**	**Color ID**
R2, R4, R6, R8, R10, R12, R18	1 k resistor	Brn/Blk/Red
R3, R5, R7, R9, R11, R13, R14	330 Ω resistor	Org/Org/Brn
R16	1 k Ω trimpot	
R17	4.3 k resistor	Yel/Org/Red
R1	8.2 k resistor	Gry/Red/Red
R15	680 Ω resistor	Blu/Gry/Brn
D1, D7	Red LED	
D2, D6	Yellow LED	
D3, D4, D5	Green LED	
D8, D9	1N914 or 1N148	
D10	5.1 V Zener 1N4733	
U1, U2	LM324 IC	
PC Board	080-00240A	

Table 1. Parts list.

has two sides, and usually the components go on one side (the "component" side) and the solder connections are made on the other (the "solder," "foil," or "track" side). Sometimes, though, you might need to attach a component to the solder side of the board, or make solder connections on the component side.

And sometimes connections are needed on both sides of the board; this is called a double-sided board (actually there can be layered boards, too, with circuitry on one or more layers within the board). With double-sided boards, there is usually a requirement for connections between the two sides. Sometimes you will need to install "vias" or "feed-through" wires, which are soldered on both sides of the board. In other cases, the board comes with "plated-through" holes, meaning a metal grommet has been inserted in the component holes, which makes the connection between the two sides.

The "tracks" or circuit connections on the solder side of the board can be of pure copper or an increasingly wide variety of alloys. Pure copper boards occasionally carry enough oxidation that you should clean them before you start working with them. You can clean them with hot water and detergent, and scrub *lightly* with a scouring pad, but in my experience it's seldom necessary with commercial kits.

There are two "premium treatments" that can make boards easier to work with. A board can be "solder-masked," which means the tracks and areas between the solder pads have been covered up with a material that solder won't stick to (making solder bridges a lot easier to avoid). And the component side of the board can be silk-screen printed with an outline of the parts and identifiers for each part, making it hard to get a component into the wrong holes. Unfortunately not all boards have these features (the VM-110 being an example of a single-sided board without solder-masking or silk-screening).

Moving right along

But first, as Norm Abrams of *This Old House* would say, "a word about shop safety." We're not working with power tools here, but you do need to be careful with a couple of things. When you clip a lead from a circuit board, the clipped end is likely to go flying and could easily hit you in the eye. Wear safety glasses, if you have them. Ordinary glasses are probably of some value, and you can also put a fingertip on the lead before you clip it to keep it from flying. I've had a *lot* of things hit my glasses, so I know there really is some risk here. Soldering? Well, you're working with molten metal. What can I say? Be careful! And don't expose yourself to the fumes any more than you have to. Don't panic—normal hobbyist exposure to solder fumes should be harmless, but on the other hand don't take any unnecessary chances.

At this point, we should have the parts all inventoried, have our tools in place, and generally be ready to start working on the circuit board.

Populating the board

I've always loved that expression: "populating" a circuit board. It conjures up images of real creativity and procreation, or something. When my children were small they thought I was building little "cities," and they loved to build their own cities with junk box components and a piece of Styrofoam. In any case, that's the term we use when we're talking about soldering components onto a circuit board.

Order of instruction can be important, so you can treat the following guidelines as rules of thumb which are

Basic Resistor Color Code

Mnemonic Tip	Color	Value	Multiplier
Big	Black	0	1
Boys	Brown	1	10
Race	Red	2	100
Our	Orange	3	1,000
Young	Yellow	4	10,000
Girls	Green	5	100,000
But	Blue	6	1,000,000
Violet	Violet	7	10,000,000
Generally	Grey	8	100,000,000
Wins	White	9	1,000,000,000
	Silver		10% tolerance
	Gold		5% tolerance

Notes

1. Most resistors you encounter in kits will have four color bands: two significant digits, a multiplier, and a tolerance band. No tolerance band indicates 20% tolerance, but these are rare now. An easy way to calculate these values is to write down the first two digits, then add the number of zeros represented by the third (multiplier) band.

2. Resistors also carry power ratings, and if your kit contains resistors of more than one rating you will have to guess at those based on the physical size. Most that you encounter will be 1/4-watt, and size is relative to power rating, so for example a 1/2-watt resistor will be larger than a 1/4-watt one.

3. Silver and gold can be multiplier bands if they appear as the third band. In that case multiply the first two digits by .01 for silver and .1 for gold. For example, Red/Red/Gold/Gold would be a 2.2 Ω resistor, and Red/Red/Silver/Gold would be a 0.22 Ω resistor, both having 5% tolerance.

4. Precision resistors can have five bands, with three significant color digits, and a wider space between the multiplier and tolerance bands.

Table 2. *Basic resistor color codes.*

applicable to just about any kit. A good case to watch for is where there are progress checks as different parts of the circuit are completed, in which case you will have to do everything in the order described in the instructions (except maybe the IC sockets!).

Sockets first

Start with sockets for the integrated circuits, *regardless of what the instructions say.* I have yet to encounter a situation where this is a bad move, whereas I have often run into trouble trying to hold the darned things flat amid a forest of previously-installed components. The solder pads for ICs are also very close together, and it's a lot easier to solder them if the board is otherwise empty! Double-check the orientation of the socket (there should be a notch at one end corresponding to the notch on the chip itself). Insert it into the component side of the board, then flip the board over so that it lies flat on top of the socket and hold it while you solder pins on diagonally opposite corners. Then solder the rest of the pins, going back and forth from side to side. Soldering adjacent pins puts an awful lot of heat into a small area of the socket (or chip) and alternating sides allows for a bit of cooling. Remember to check the soldering as described last month before you go on to anything else. Most kits which use integrated circuits will include sockets for them. If not, run down to Radio Shack™ and buy sockets! They make working with ICs a whole lot easier and safer. Very rarely the circuit may be so sensitive that the additional "lead length" for a socket will cause problems, but usually the instructions will tell you that. Do *not* install the chips into the sockets until (a) you are instructed to do so or (b) as the very last step before applying power to the completed project.

Little flat things

Next, install the small components that lie flat, such as resistors and diodes. The reason for doing these next is that after you have installed taller components, it can be difficult to get the lower ones into position. You can do all of the resistors at this point, even vertically-mounted ones, or you can leave the vertical ones for later. For the flat-mounted components, hold the component in one hand and use your long-nose pliers to bend the leads at a 90° angle, close to the body of the component. Don't hold the head of the pliers right up against the body, though, because you can damage the component that way. You will be bending the component into a "U" shape which should slip right into the holes on the circuit board. If it doesn't fit, straighten the leads and do it again; don't try to adjust it by forcing it into position. Once the body of the component is flush with the surface of the board, bend the leads outward at about 45° on the solder side. Install three or four components, then solder them.

When you install components vertically (e.g., resistors and RF chokes), one lead goes straight down through the board and the other is bent down 180° alongside the body of the resistor, so one end of the body is snug against the board. The parts overlay diagram will usually have a circle around one

of the holes, and that's the one that the body goes against. The component is not polarized, so it doesn't matter which way it goes in, right? Wrong! Often you will need to use the exposed (bent) lead as a test point, and if you put the component in backwards you will have problems later because the needed side of the resistor is not accessible from the top of the board! The VM-110 parts overlay diagram illustrates vertical component mounting quite nicely (see R17 and D10).

Everything else

Do the rest of the components in no particular order, or in the order listed in the instructions, or in whatever order you prefer. Three common approaches are (1) to work your way across the board from corner to corner, or (2) to work your way upwards in component size, or (3) do all the components of a given type. Each approach has its fans, and you'll eventually decide which works best for you.

Leave any off-board controls or wires until last, unless instructed otherwise for reasons of progressive testing.

It doesn't fit!

Sometimes you will find that a lead or wire is too thick to go through the hole in the board, or the spacing of the holes is slightly off. This happens because the kit suppliers work with batches of kits, and exactly the same component might not be available. You can narrow the lead diameter *slightly* by scraping it with your hobby knife, or you can widen the hole with a small drill, or even by pushing a small screwdriver through it. If you widen the hole, be careful that you don't damage the solder pad, though. If the holes are improperly spaced, you may be able to fix the problem by soldering the component onto the tracks on the other side of the board (be extra careful about orientation, though).

Remember to check off the parts on the parts list or overlay diagram as you go. This will help to make sure that every component is installed. When you are done, another handy trick is to hold the board up to a light and look for empty holes. Usually there won't be any. Sometimes, though, the circuit has changed, or the same board is used with other circuits, or the designer had extra holes drilled for some other reason, so empty holes don't always mean there are missing parts.

Take a break

Your eyes are tired, your hands are getting shaky, you're getting a headache ... It's a huge temptation to do "just one more resistor" or "finish up the caps," or go ahead and "fire it up," but when you're tired you're far more likely to make mistakes. Don't try to finish the project in one session if more time is needed. You'll probably complete the VM-110 in under an hour, but for larger projects I find a 10- or 15-minute break every hour is very helpful. Traditionally, I finish building kits late at night, and I have learned over the years that it is best to ignore the temptation to test them immediately. They almost always work better the next day!

The VM-110 board in particular

You can probably build the VM-110 in accordance with the generic construction steps described above, but let's look at some specifics.

You've probably noticed that the instructions are pretty rudimentary. For example, step 4 tells you to "Insert and solder the LEDs and jump (watch polarity of LEDs)." How high are you supposed to jump?

Well, they mean you should install the "jumper" between two holes on the right side of U2. It's any little scrap of bare wire, such as the trimmed lead from a resistor. Do it when you do the resistors, or you will find it pretty awkward.

Several of the components (resistors and diodes) were supplied on "ammo strips," or held together with paper tape on the ends. Generally, you cut them free of the paper strip with your flush cutting pliers, and generally you never pull them loose (or you could damage the component). But there are always exceptions, and in my VM-110 kit the 1 k resistors had unusually short leads. If you cut them from the tape, you will find that there isn't enough lead left on R6 to mount it vertically. For just this one resistor, scrape the tape off the ends of the leads rather than cut it free. This is the kind of problem that is almost impossible to anticipate, so treat this warning as a freebie. Since I cut the resistor before discovering the problem, I had to find a solution, which turned out to be a spare 1 k resistor from the junk box. It's also possible to solder a new piece of wire onto the original one if you're careful.

Installing the light-emitting diodes (LEDs)

We need to think a bit about the LEDs before installing them. First, we need to select an order, since we have three green ones, two reds, and two yellows. The order suggested in the parts list is fine for me [(reds on each end, then yellows, and three greens in the middle (D3-5)], but feel free to do it differently if you want.

You should be able to detect the flat side of the LED (just a tiny flattening on one side of the plastic ridge at the base of the body), but you can always check with a battery. Touch the leads to the terminals of the battery (1.5 or 9 V) briefly, and if the LED lights, the positive lead is the one in contact with the positive terminal. If it doesn't light, turn it around. (Make sure you use a current-limiting resistor with the higher voltages.)

The other thing we need to think about is what we are going to do with the board when it is finished. Ordinarily you might install the LEDs flush against the component side of the circuit board, but if you do it that way how will you mount it in a box? The ICs, vertically-mounted components, and trimpot (R16) all stand higher than a flush-mounted LED, so it will be difficult to mount the board in an enclosure in such a way that we can actually see the LEDs. Mount the LEDs above the board, with the base of each LED

LED 1	LED 2	LED 3	LED 4	LED 5	LED 6	LED 7
100	105	111	118	123	128	132

***Table 3.** Voltage readings.*

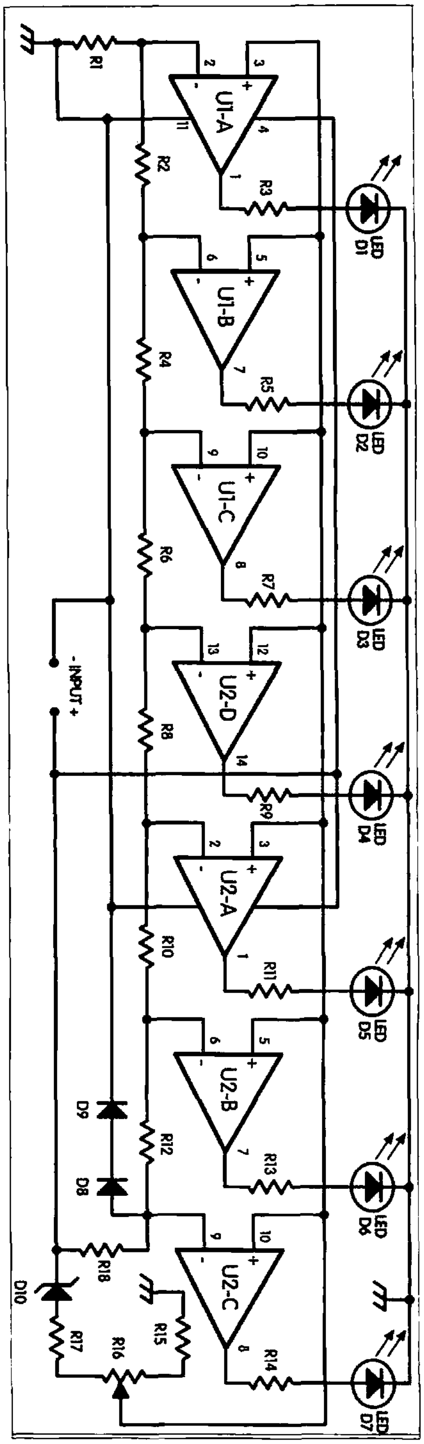


Fig. 1. VM-110 schematic.

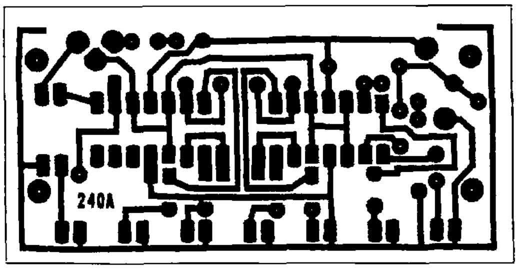


Fig. 2. VM-110 PCB.

about half an inch above the surface of the board. Visually check that the base of the LED is higher off the board than the other components. The leads could be bent 90°, but we are going to mount the board by inserting the LEDs into holes and gluing. Install the two end ones first (D1 and D7), measuring carefully; then you can just line up the interior ones (D2–6) visually.

Installing the integrated circuits

Integrated circuits are sometimes tricky to install, and as a rule the more pins they have the trickier they are. Some (particularly CMOS devices) are extremely sensitive to static electricity, so you should make sure you have provided a static discharge path to ground before handling them. It may seem like a good idea, but never use a clip lead from your watchband to a convenient ground. If you do that you are *really* grounded and if you should happen to come into contact with a live wire, the results can be pretty drastic. A much better bet is a commercial electrostatic discharge strap (disposable ones are inexpensive and can in fact be used many times). A commercial ESD strap has a resistance built into it, so while static will drain away to ground through it, a large current will not. It's also a good idea to ground the circuit board before inserting the chips. Connect a clip lead between the ground track (usually around the outer perimeter of the board) and a convenient electrical ground.

Make sure the ICs' pins are straight. Sometimes one or more will be bent out of line, and they are likely to fold under or outward as you try to insert the chip if you don't straighten them. Usually you will see that all of the pins are bent out at a slight angle from the vertical. In a commercial environment they are inserted with a special tool or by machine. To do them by hand you must bring the pins to vertical first. Grasp the chip firmly with your thumb on one end and middle finger on the other end, and press the pins at an angle against a flat surface such as the top of your workbench. Turn the chip around and do the same on the other side.

When you insert the chip, watch closely to see that all pins are going into slots, and not bent under or outward. If a pin bends under it can be extremely

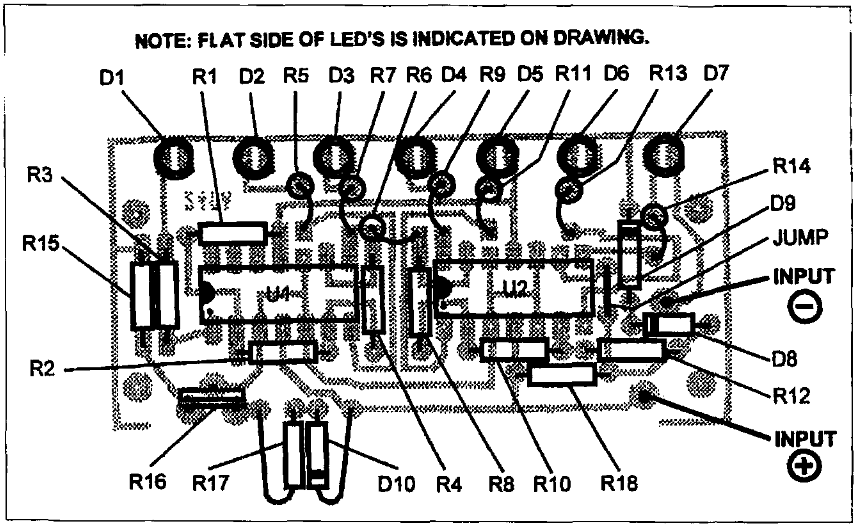


Fig. 3. Component overlay.

difficult to find later when the device doesn't work! Press the chip firmly into the socket.

Cleaning up

You're nearly through building, now, so it's a good time to tidy up. Clean away any trimmed leads lying around your desktop (they can easily get into places they shouldn't and short things out!). Some builders will suggest that you clean the excess solder flux off the board, but I usually don't bother. The flux removal process is mechanically rough on the board, and seems to cause more problems than it solves. Sometimes, though, I will go back and clean a board where I suspect, but cannot find, a solder problem. I don't like doing it because it is messy and dangerous (unless I use a commercial flux remover which is messy, dangerous, and expensive). I use acetone (readily available in grocery stores as fingernail polish remover) in a *well ventilated area* and a paint brush for most ordinary fluxes. There are water-soluble fluxes available, but if you use those, please be sure the board is *thoroughly dry* before it comes into contact with any electricity!

Probably the best alternative is to use solder containing a "low-residue" flux. It's a little more expensive, but worth it.

The smoke test

The smoke test is a time-honored tradition in ham radio and electronics construction. It's the point at which you apply power to a device for the first time, and see if anything catches fire or emits smoke. And we're ready for the smoke test on our VM-110 now, right? Wrong! There are still two things to do. First, take one more close look at the board, the component orientations, and the soldering. Second, use your multimeter across the power connections on the circuit board to make sure there is no short. On the power input of most circuits you should find either an infinite or at least a very high resistance. If you measure no resistance (or if your multimeter has an audible continuity tester and

you hear the tone), look for a short. If there is a low resistance, look at the circuit diagram and trace the current path from the power supply. Sometimes a low resistance will still allow the tone to sound on an audible continuity tester, so if you hear the tone you might just want to measure the resistance and see if it is zero (a short) or a few ohms (possibly OK).

When you are ready to connect power for the first time, you should be ready to disconnect it very quickly, or apply it only for a moment. With the VM-110 I'd suggest that you connect 12 V from your station power supply using clip leads. But if you don't have a 12 V supply, you can use the plug pack transformer and plug it into the wall outlet as a way of switching it on and off. Note that the instructions say that the "solid wire is the '– input.'" By this they mean the solid-*colored* wire (without the white stripe); they don't mean solid wire as opposed to stranded wire!

Connect the ground (negative) lead first and then just *momentarily* touch the positive lead to its connection on the board, or if your power supply has a switch, connect both leads and turn the switch on momentarily. If you blow a fuse, you know you have a short circuit somewhere on the board. If you have a "protected" power supply, it would shut itself down (sometimes you can see this on the supply's voltmeter) without blowing a fuse. If a short circuit is evident, review the soldering and component orientations (especially diodes near the positive power input connection).

If you haven't blown a fuse, you can connect the positive lead and check for smoke. Look and listen! Sometimes you will hear a crackling sound before you see or otherwise detect a problem. Look for actual smoke, for a resistor turning brown. If everything looks OK, you can make the power connection permanent and continue to set up and operate your device.

I've said "look and listen," but in fact you should use all your senses with the possible exception of taste. Sometimes you might see or hear a problem, and sometimes you might touch a resistor or transistor to see if it is hot. But don't overlook your nose, in a manner of speaking. Even if everything else seems OK, you might notice what we sometimes call a "brown smell." New electronic equipment does have a characteristic smell, but a brown smell is unmistakable. A light brown smell indicates that disaster is imminent. A dark brown smell indicates that the disaster has already happened.

If you know how much current the circuit *should* draw, and have a multimeter or ammeter which can handle that range, you should connect the meter into the positive power supply line before conducting the smoke test. Connect the positive lead of the meter to the positive side of the power supply, and the other "common" or "negative" lead to the positive input connection on the circuit board, so current will flow from the supply through the meter and into the board. If you can measure current, you can often see a problem (e.g. excessive current drain) before components are damaged. Similarly, low current drain (that is, below the specifications or your expectations) might indicate a problem in the circuit.

Finally, with power applied to the VM-110 circuit, adjust the variable resistor (R16) back and forth and you should see all of the LEDs progressively light up and go out as you adjust R16. Congratulations! Your VM-110 is *built!*

Calibration

At this point, you have a working VM-110 and all that's left is to calibrate it. The instructions say that to "properly calibrate your kit you must be able to monitor and adjust the incoming AC." The ability to adjust the incoming AC is probably beyond most of us, but fortunately it is enough to be able to monitor it. You *do* have a multimeter, right? Set it on the AC voltage range and carefully measure (and note) the voltage at the outlet you will plug the transformer into.

Safety first!

Unlike most of the electricity that you will be working with when building kits, AC mains current is DANGEROUS. Make sure you are holding the test leads well back from the metal tips!

The "normal" AC supply voltage is capable of changing fairly dramatically depending on the total electrical load in your house and the quality of the supply from the power company, so it is a good idea to watch the meter for a minute or two and make sure that it is reasonably stable. If it isn't, check for electrical equipment being turned on and off in your house, and if necessary put the whole thing aside until late at night when a stable supply is virtually guaranteed.

Now connect the VM-110 (plug in the transformer) and adjust R16 so that the appropriate LEDs are lit, in the order mentioned in the first paragraph of this article and **Table 3**. For example, if you measured 120 volts, adjust R16 until LEDs one through three are lit. Continue until LED 4 is lit and then tweak it just the tiniest fraction farther (but not enough to light LED 5). That's it—we're done!

Next time we'll look at putting the finished VM-110 into an enclosure. We'll be using a plastic box, Radio Shack's 270-2712, or any other little box you might happen to have lying around. But now it's time to pat yourself on the back, grab a vessel of your favorite beverage, kick back and admire the pretty lights.

The Rainbow Kit VM-110, $10.95 (+$5 s/h) is available from Milestone Technologies Inc., 3140 Peoria St., Unit K-156, Aurora CO 80014, or call (800) 238-8205 for credit card orders. It is also available from Electronic Rainbow Inc., 6227 Coffman Road, Indianapolis IN 46268, or call (317) 291-7262.

NEVER SAY DIE
Continued from page 5

and was able to feel his feelings and even "remember" his name—after he was dead. His cells either had great memories, or they were connected in some way to wherever his memories were stored.

With some research we might be able to take a few cells from a murdered person and find out from them who did the dirty deed. That sure will call for some big changes in law enforcement and trial law.

If we find that we can pass data via biocommunications systems we may some day have tiny communications systems which fit in a wristwatch. It just takes a couple of cells in a medium to keep them alive and a suitable detector/modulator. We might have to soak our wrist communicators in a nutrient solution every night.

Yes, this is far out, but not one bit of it calls for a technology that hasn't been demonstrated to have the potential.

Heck, I've been editorializing for over 30 years now about the potential market for snap-on roller skates so we could zip around cities faster and easier. But you've ignored me. Now I see that Rossignol, the ski company, has announced just such a product, which they're calling "Traffic." They're walking shoes that in-line roller skates snap into for instant skating.

And I even ran an article on how to build a legal radar jamming unit which not one reader picked up on. Not one! Now, 10 years later, it's a multi-million dollar market.

But then I've been preaching health for years and when I look around at hamfests and club meetings I see great big fat constipated guts and guys smoking. Talk about stupid!

So who's going to do the R&D so we can have a better, cheaper, faster communications system? Biocommunications?

The next step with that is researching communications through time, with the dead, and maybe with our ET visitors. Too far out for you? That just means that you haven't been doing your homework. After all, people who experience near-death come back and tell us about meeting dead friends and relatives, all with their memories intact. And we get the same reports via contacts through psychics with the departed.

QRM Reduction

A letter from Bob Chamberlain KE6KGO, the editor of the Inland Empire ARC newsletter in Fontana, California, likes the idea of hams demonstrating their code

Continued on page 40

NEVER SAY DIE
Continued from page 39

skills once a year. "After all," he says, "you have to renew your driver's license every once in a while and have to take a proficiency test for that."

Maybe in California, but I've never had to take a test for my driver's license. When I got my first license they asked the guy who drove me there if I could drive. He said yes and that was that. I've never been retested, and that was over 50 years ago.

Now, regarding code and the ham license. Many years ago I jokingly suggested that all hams be required to be retested when their license was renewed. I'm still getting hate mail for that one. Well, I remember what happened when the League petitioned the FCC to require Generals to upgrade to Advanced in order to continue on the HF phone bands. As I've mentioned a hundred times, that brought about the greatest catastrophe in the history of the hobby. Fortunately the FCC only took away half of the phone bands.

The best way to get rid of around 90% of the General, Advanced and Extra Class licensees would be to require a code proficiency test for license renewal. "I'm not going to learn that damned code all over again!"

My original reasoning stemmed from the League's statement that the ability to use code is extremely important for emergency purposes. That was when they were doing everything they could to stop the no-code movement. They got hundreds of ARRL clubs to file comments to this effect with the FCC. If that statement was true, I suggested, then the continuing ability to use Morse should be tested.

If you agree that the code is an important skill and should be required for a ham license, then perhaps it's time we petitioned the FCC to make VEs institute such tests for renewals. Further, we don't want any of that 1920s kind of hand key crap, hams should be able to at least demonstrate their proficiency with speed keys. And, again, if the code is critically important, then hams should be constantly improving their skills and should demonstrate their ability to copy the code faster with each renewal.

However, another important aspect of the hobby is a familiarity with building techniques. Perhaps if the first renewal required the assembly from a box of parts of a spark transmitter? That would certainly be in keeping with the code skill requirement. On the second renewal we could build a small tube receiver. On the third a transistor unit. On the fourth an IC rig. And that'll take everyone up to about 65 years of age where, unless their eating habits have changed substantially from today, most will be dead.

All in favor say "aye."

Runny Noses

The following piece arrived via E-mail. It's something I've wanted to write about, but Dr. Millikin has saved me the trouble:

I'd like to call your attention to an article in the magazine *Discovery*, for February, 1997. Written by Kevin Krajick, a New York freelance writer, it highlights how little we know about airborne microbes and how they spread. For instance, in one study, the chicken pox virus was found in the air from a hospital patient's room *and* down the hall on the day *after the* patient had been discharged. For a layman, Mr. Krajick does a creditable job on hospitals and biological warfare, but there's another *very* important area that didn't receive much attention.

For example, the current American lifestyle has created a veritable paradise for respiratory pathogens in our public facilities. Now, we all breathe the same air, winter and summer. Our shopping malls, supermarkets, department stores, and discount houses *all* have central heating in the winter and air conditioning in the summer. The same applies to our theaters, courthouses, and office buildings, as well as to our public transportation, including airplanes, trains, buses, and even taxis.

Of particular note are our day care centers and our schoolhouses, because when a young child encounters a pathogenic microbe, it is usually the child's first exposure to it, meaning that no immunity has yet developed to it. Those "first infection patients" tend to shed the offending microbe into the environment in huge numbers, which facilitates its spread to their siblings, classmates, parents, and the entire community.

And finally come our hospitals, where we concentrate the germiest people in town. In all the above places, a breath of fresh air is now a rarity.

Admittedly, respiratory viruses haven't killed people in wholesale lots since the 1918–19 flu epidemic, but they certainly *do* take their toll on the very young, the very old, the immunosuppressed, and those with other diseases, such as heart trouble or diabetes. As for the impact of respiratory infections on the remaining "healthy" population, we have only to look at the number of work days lost every winter. Even so, that still doesn't account for the resulting human suffering, and the billions of dollars we spend every year trying to relieve it.

Indoor plumbing, safe water supplies, pasteurization, and food inspection have made a huge dent in orally transmitted

pathogens. Isn't it time we tried to make a similar dent on the respiratory front? Does anyone have any idea how vulnerable we might be if a really virulent emerging microbe became adapted to respiratory transmission? The plague bacillus can do it. Suppose a Hanta or an Ebola virus, or even the AIDS virus somehow became adapted to our nasal or bronchial system. Would we be in trouble?

Is anything being done about the situation? Apparently not much. What have you heard about filtering viruses from the air in a shopping mall? Or about disinfecting the droplets deposited on its floors, counters, doorknobs, telephones, toilet handles, or faucet taps?

Have you ever thought about the shopping carts in your supermarket, especially the ones with seats for infants, with their runny little noses and busy little hands? I checked on that some years ago with a major supermarket chain, and found that they sprayed their carts once a week with a steam hose. Is that adequate? All you have to do after using a cart is to rub your nose or eyes with either hand.

In short, very little seems to be known about the spread of our respiratory pathogens via our public facilities. Are shopping malls and supermarkets potentially hazardous to our health or not? Is it worth a pilot project to find out?

OK Conspiracy

One of our readers, Roy Lavender, of Long Beach, California, mentioned that he was curious about some of the details of the Oklahoma City bombing, which used 4800 pounds of ammonium nitrate in a rental truck.

Roy points out that when he was a kid he used to blow stumps on his family's farm using ammonium nitrate. He said that he had to stay away from the hole for several minutes until the brownish fumes from some nitrogen compound dissipated. One whiff and he'd have a pounding headache.

He noticed the same precaution when he used cratering charges in the Combat Engineers in Word War II. They were told during training that a single lung full of that compound would kill.

There was no mention of headaches or falling over dead after the explosion in Oklahoma City by any of the people in the agencies that were first on the scene.

As I recall, several building demolition experts have claimed that the pattern of destruction could not have been caused solely by a truck exploding outside the building.

On the other hand, what kind of an idiot would ever even suggest that our government might be lying to us?

Oh yes, Roy also brought up the fact that the continuously running seismograph at the U of OK at Norman registered two surface waves made by the explosions, ten seconds apart. If the truck made one wave, what could have made the second?

Jobs

With the lowering of shipping costs, the movement of capital anywhere in the world in seconds, the lowering cost of communications and the proliferation of computers, jobs are going to tend to move to the areas of the world which have the lowest labor costs. And that sure isn't America. There will be increasing efforts to stem this movement via legislation, but that's as doomed to failure as attempting to stop the tides with sandcastle walls.

One more strike against America in this global business village is our continued lowering of educational standards. Well, we're already dead last of the developed countries in our quality of education, again proving that the socialist approach to doing things, no matter the lofty liberal ideals driving them, are going to fail, just as socialist schemes have failed in every country where they've been tried.

But even knowledge isn't going to make a lot of difference for most "jobs." We are, more and more, automating the routine work and hiring the cheapest labor in the world to do the unautomated work.

No, I don't have a good solution to the problems this presents, at least as far as

Continued on page 45

Hamtronics' TD-5 Subaudible Tone Encoder/Decoder Kit

Guaranteed success.

Larry Antonuk WB9RRT
P.O. Box 452
Marlborough NH 03455

Our local repeater had been converted to CTCSS (PL) operation several years ago, and most of the members of the club had long since switched over to synthesized programmable rigs. Still, every once in a while someone would show up with an old crystal rig or some commercial radio that needed an add-on CTCSS encoder. We had explored lots of options, and found that the boards from Hamtronics provided a good mix of high quality and reasonable cost. These were available in kit form as well, so we could save a few bucks by doing the soldering ourselves. We had used several different versions over the last few years, and were very pleased with the results.

It was no surprise, then, when the latest club member walked into a meeting with a newly-acquired rock-bound rig and a small package from Hamtronics. The surprise came when he opened up the package. It seemed that the current Hamtronics CTCSS encoder had been upgraded to the new TD-5 configuration. Suddenly things weren't quite as straightforward as they'd been with some of the previous kits.

The first thing that tipped us off was the fact that it seemed like half the parts were gone. We checked the kit against the parts list and of course everything was there—it just seemed like 22 parts weren't quite enough to get something like this to work. The reason for this apparent shortage was the fact that the TD-5 is based on a special-design IC, which is a complete tone generator/decoder system on a surface-mount chip. This chip digitally synthesizes the tones, so they are selected by flipping binary switches—no more 10-turn pots to adjust.

Once we had all the parts laid out, another small problem became obvious—our previous projects had all been "through-hole" PC boards. This was our first brush with surface-mount devices (SMDs). At first this seemed like a roadblock, but after a quick announcement it turned out that quite a few of the club members were used to working with SMDs.

There were basically two camps on this topic. The first camp believed that you needed special soldering equipment to mount SMD ICs. One guy had access to a station at work that used a stream of hot air to melt the solder on the PC board where it contacted the IC—on all 24 pins at once. The second camp had done some home-brew SMD work before, and claimed that all you needed was a very sharp soldering pencil, a bright light, and a good eye. This argument progressed back and forth for quite a while, and in the end the sharp-soldering-pencil group won. A couple of the guys wound up taking the board and parts home that night, and did the touchy soldering work.

When we examined the completed board at our Saturday morning breakfast it looked great—just like a commercially manufactured soldering job. The technique they used was the same as that described right in the Hamtronics instruction sheet—positioning the chip, tacking down opposite corners, then carefully soldering each pin. Not only did these guys do a good job, they maintain that this is the *only* way to do this process.

Once you decide that you need special equipment to do a job like this—equipment out of reach of most hams—you cut yourself off from a great many current kit choices, and probably

a majority of those being developed in the future. By tackling SMD jobs yourself, you gain experience a little at a time, and soon you have the confidence to tackle any SMD job you might come across.

In any event, you definitely need to observe static preventative procedures when you work with this type of IC. This includes a grounded soldering iron and a wrist strap connected to an appropriate ground. (As we passed the board around the breakfast table on Saturday morning we kept it in the pink static-dissipating bag provided by Hamtronics—just in case.)

Our next task was, of course, to mount the board in the radio, so a few of us went right to work after breakfast. The TD-5 can be configured as an encoder, a decoder, or both. It won't do both at once, however; if you have a need for simultaneous encode and decode—like if you're building a repeater that uses PL on the output as well as the input—you will need two TD-5s.

We were going to use the board just in the encoder mode, but we had a small problem. Our ham with the rockbound rig was a commuter, and he had the radio set up on two different repeater frequencies. Of course, one was across the state line, and used a different PL tone.

The TD-5 can encode any of the 47 PL tones from 67.0 to 254.1 Hz. The proper tone is selected via a six-position dip switch on the board. But how do you change tones in normal operation? We couldn't re-mount the dip switch on the front of the radio. Even if we could, it wouldn't be too safe to try to switch in those different combinations on the interstate. We were kicking several possible solutions back and forth, and then one of us came up with the answer: Read the manual.

OK, so we didn't actually have to *read* the manual, we just had to look at the pictures. Hamtronics includes a diagram (and a thorough explanation, of course) of how to accomplish just what we were trying to do. The answer is fairly simple. The dip switch works by pulling down lines on the encoder/decoder IC. Any of the switch positions that are ON pull the corresponding lines to ground. All six of these lines are read by the IC, and it produces a tone depending on the code that corresponds to the current combination of grounded lines. It's a fairly simple matter to just leave all the switch positions open, and run wires from the dip switch to a two-position toggle switch.

For instance, suppose you needed the tones 167.9 and 123.0. These two tones need switch combinations of 101010 and 010101, respectively. (Grounded lines = 0.) Just connect the wires from positions 2, 4, and 6 to one side of an SPDT switch. Connect positions 1, 3, and 5 to the other side of the switch, and connect the common side to ground. Now when you flip the toggle switch you will select either 167.9 or 123.0 Hz. It should be obvious that this will work fine, as long as the two tones you need don't share any common switch positions. If they do, you will note that the two sets of 0s basically combine, since all the pins are effectively shorted together. Luckily there's a fix for this problem—blocking diodes. By connecting each pin on the board to the toggle switch via a diode (1N914 or 1N4148) you create a situation where the pins are isolated from each other by a back-to-back diode combination. This is known as a diode matrix, and can be extended out for any number of tone choices. You just need a multi-position switch, and plenty of diodes. The manual gives detailed instructions on how to set up a diode matrix for the tone frequencies you need.

Once the tone switching was figured out our next step was to find a spot to inject the tone. This is sometimes a challenge, especially in older rigs. The key is to find a location downstream from the voice processing circuits (that could filter out the tone you are trying to inject) but far enough upstream so that the tone board has enough output voltage to properly modulate the transmitter *and* doesn't load down the voice audio. In our case the solution was easy. The rig we were working with had originally had an option for a PL board, so we tried an empty pin labeled CTCSS INPUT. (Hey, it was a long shot, but it worked.)

Continued on page 44

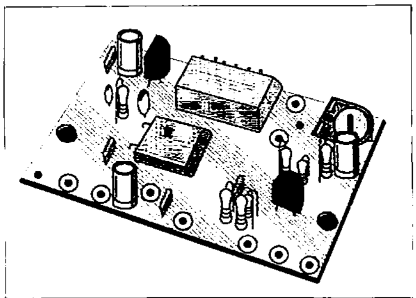


Photo A. Hamtronics' TD-5.

We used the onboard potentiometer to adjust the tone level, using our tried-and-true empirical split-the-difference approach. First, we found the spot where the tone level was just barely too low to key up the repeater, and marked this point on the potentiometer. Then, we turned up the tone level until it got to the point where you could hear the PL tone as an annoying buzz in the speaker, and marked this point. We then set the pot to a point midway between the two marks. (OK, this isn't highly scientific, but it works well until we have time to swing by and visit our buddy with the radio shop. At that point we normally set our deviation to 300 Hz.)

That completed our simple tone encoder application, but there were a couple other items of interest that may be worth mentioning. Both of these have to do with tone filtering, and the concepts of "talk-on" and "talk-off."

Some deep voices (usually males) have audio components that are in the subaudible CTCSS tone range. Talk-on occurs when voice components appear at the repeater input that are the same frequency as the desired CTCSS tone. This can cause the repeater to key up intermittently and then drop out, if the repeater hears a transmission that does not have the correct PL tone, but does have some voice components in the PL tone range.

Talk-off, on the other hand, occurs when the correct tone is being transmitted, but the voice components happen to be of the same frequency but exactly out of phase with the PL tone. This cancels out the PL tone, causing the repeater to drop out for a second or two in the middle of each sentence. In either case the solution is to filter the voice audio before it is transmitted, removing all the tones that fall below 300 Hz. Then the only frequencies in the CTCSS range that can modulate the exciter will be coming from the tone encoder itself—not from any part of the voice audio. The TD-5 contains a built-in high-pass filter that makes it simple to filter these tones out of your microphone audio. Just loop the audio through two pins on the board, and your audio is automatically filtered. Likewise, the TD-5 contains a similar filter for the RX audio. This allows you to pass your RX audio through the chip to remove any remnants of PL tone on the received signal, removing that low-level buzz. This same filter can also be used to mute the RX audio, if you choose to break the audio path rather than use the transistor output to switch off the receiver. (Muting the RX audio is more likely to be used in commercial rather than amateur applications, but this might come in handy in some special ham applications.)

A final point concerns the PC board itself. We had been used to seeing some pretty high-class boards from Hamtronics over the years, and the TD-5 was no exception. One point that did catch the eye of one of the club members was the use of "thermal" connections for the ground hookups. Since these connections hook directly to the large ground plane they are often very difficult to solder—the ground plane draws the heat from your soldering iron away as fast as you can pour it on. You often wind up heating up everything on the board except what you're trying to solder.

Thermal connections have a central ring that is separate from the ground plane, but connected with four thin traces. These traces make good electrical connections but don't transfer heat very well. They solder right up with no problems. Some of the club members argued that this was just good engineering practice, and that they would expect no less. Others thought that this was another sign that Hamtronics really understood their customers. Being hams themselves, they realized that not everyone has industrial-quality soldering tools, and this was a way to make it easier for the average hobbyist. Whatever the reason, it's just another point to add to the long list of things that make Hamtronics kits easy to build.

Whether it's the quality parts and boards, the explicit instructions, the troubleshooting tips, the modification suggestions, or the "thermal" connections, it all adds up to a product that almost guarantees kit-building success. Our group has found this to be the case over the years, and the new TD-5 CTCSS encoder/decoder is no exception.

Information on the TD-5 CTCSS encoder/decoder is available from Hamtronics, Inc., 65 Moul Road, Hilton NY 14468-9535. Telephone (716) 392-9430, FAX (716) 392-9420.

NEVER SAY DIE

Continued from page 41

working for a large corporation is concerned. They're going to continue to need fewer unskilled workers, automate the skilled jobs as much as possible, and downsize their administrative staffs via computers and better communications. Even sales staffs will be cut as more of the sales effort can be moved to the Web and direct sales gradually edge out retailers and distributors—as we're seeing in the computer distribution business.

As a known Mac addict I get a steady stream of catalogs from MacMall, MacWarehouse, MacConnection, MacZone, Express Direct, CDW, and Power Computing. Who needs a computer store where I'd have to help pay for their location, the sales staff, extra shipping, support staff of bookkeepers, maintenance, shipping people, and so on?

So what's the answer for the average wage slaves? Are they going to have to make do with ever-lowering incomes?

Of course my proposal is to aim toward starting your own business. Keep in mind the truism that you're never going to make much money or have much real security working for someone else. Well, except maybe for the government, where job performance and skills are often irrelevant. But we already have more people working for the government than we have in manufacturing, so that isn't an infinite source of limited, but easy, money.

Neither is opening a mom-and-pop retail store, and then wondering what happened when a Wal-Mart™ moves into the neighborhood. No, the bridge to beating the game lies in owning your own business, selling a product in a fairly narrow niche. Look for a business where you can generate just a few million dollars in sales a year. If you get much larger the megacorporations will come to see you. I've been there and done that. When my magazine publishing revenues grew by 50% per year for seven years I got up to $17 million in sales and the big boys gave me a choice of selling out or being crushed. I sold out. Some of my publishing competitors said go to hell, and they did. They were all soon out of business and have disappeared.

Most of the manufacturing companies are going to need management and marketing staffs in America, so we can hold on to as many of those jobs as possible by providing a skilled and well-educated work force. But that means totally changing our whole educational system, from the way we birth babies in hospitals to preschool, K-8, high school, and college. The whole system is a dreadful mess and

Continued on page 47

Number 46 on your Feedback card

Special Events

Listings are free of charge as space permits.

Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the March issue, we should receive it by December 30.

Provide a clear, concise summary of the essential details about your Special Event.

NOV 29

EVANSVILLE, IN The 5th annual EARS Evansville Winter Hamfest will be held at the Vanderburgh County Fairgrounds, 8 a.m.–2 p.m. Central Time. Free parking, indoor flea market, commercial dealers. For table reservations or info, call *Neil WB9VPG at (812) 479-5741; or write EARS, 1506 S. Parker Dr., Evansville IN 47714. E-mail [EARSHAM@aol.com] or visit the Web site at [http://members.aol.com/earsham/].* Setup begins at 6 a.m. Central Time on Sat. Wall spaces (2' x 8' table), $10 each; flea market tables (2' x 8'), $7 each. Admission, $5. Talk-in on EARS wide area repeater network 145.150 Evansville/146.925 Vincennes. Alternate EARS repeater 145.110(-). Use 107.2 CTCSS on all frequencies listed. Be sure to visit your friends from "The Ham Station," a major vendor and contributor for the Evansville Winter Hamfest.

DEC 6

JACKSONVILLE, IL The Central Illinois Winter Superfest, sponsored by the Illinois Valley ARC and Jacksonville ARS, will be held 8 a.m.–2 p.m. at Turner Junior High School, 664 S. Lincoln Ave. (one block north of Wal-Mart). Features include VE exams at 10 a.m. [pre-reg. required; contact *Tim Childers KB9FBI, 773 E. College, Jacksonville IL 62650. Tel. (217) 245-2061*]. Indoor flea market, radio and computer vendors, crafts, free parking, and refreshments. Admission: $3 each, 2 for $5; children under 16 free. Tables, with vendor pass, $10 each. Vendor setup starts at 6 a.m. For further information, contact *Jacksonville ARS, c/o Kaye Green KB9KHQ, 27 Ivywood Dr., Jacksonville IL 62650. Tel. (217) 245-6778.*

DEC 7

HAZEL PARK, MI The Hazel Park ARC will hold their 32nd annual Swap and Shop, 8 a.m.–2 p.m., at Hazel Park High School, 23400 Hughes St., Hazel Park MI. General adm. $5, in advance or at the door. Tables $14 each. Reservations must be received with check, no reservations by phone. Plenty of free parking. Talk-in on 146.64(-) (DART). Swap info, tables, and ticket reservations to *HPARC, Box 368, Hazel Park MI 48030.*

JAN 17

HAMMOND, LA The Southeast Louisiana ARC, Inc., will hold the SELARC Hamfest at Southeastern Louisiana University, University Center, upper level. There will be adequate display space under climate-controlled conditions, with multiple meeting rooms and excellent parking. Inclined ramps to the exhibition level will ensure easy loading and unloading. Priority will be given to past vendors who register before Dec. 1st. Commercial vendor tables are $15 for the first, and $10 for each additional table (limited to 6); all tables $20 after Dec. 1st. Swap tables are $8 in advance, $10 after Dec. 1st. No admission fee. This event will not allow flea market or craft items unless they are amateur radio or computer-related. Advertising space will be available on flyers and programs until Dec. 20th. Contact *SELARC, Inc. (Hamfest 98), P.O. Box 1324, Hammond LA 70404-1324.*

ST. JOSEPH, MO The 8th annual Northwest Missouri Winter Hamfest will be held on Jan 17th, 1998, 9 a.m.–4 p.m., at the Ramada Inn in St. Joseph MO, with special room rates for Hamfest participants. The event is being co-sponsored by the Missouri Valley ARC, Green-Hills ARC and Ray-Clay ARC. The motel is located at I-29 and Frederick Ave. (exit 47 on I-29). Talk-in on 146.85 and 444.925. VE exams, major exhibitors and flea market all indoors. Free parking. Advance tickets $2 ea. or 3/$5; at the door $3 ea. or 2/$5. Pre-reg. requests received after Jan. 8th will be held at the door. Swap tables $9 ea., first 2 tables. Commercial exhibitors welcome. Write for details to *Northwest Missouri Winter Hamfest, c/o Gaylen Pearson WBØW, 1210 Midyett Road, St. Joseph MO 64506.*

JAN 18

YONKERS, NY The Metro 70 CM Network will hold an Electronic Flea Market, 9 a.m.–3 p.m., at Lincoln High School, Kneeland Ave., Yonkers NY. Free parking, indoor flea market. No tailgating. VE exams. New and used equipment for CB operators, amateur radio operators, commercial two-way radios, computers, stereo buffs, televisions, telephones, electronic parts and kits, and much more, will be on sale. Admission is $6 for adults; children under 12, accompanied by an adult, are admitted free. For information, or to register as a vendor, call *Otto Supliski WB2SLQ at (914) 969-1053.* Talk-in on 449.425 MHz pi 156.7; 223.760 MHz pi 67.0; 146.910 MHz; and 443.350 MHz pi 156.7. Mail paid reservations to *Metro 70 CM Network, 53 Hayward St., Yonkers NY 10704.*

JAN 24

GALLATIN, TN The Tennessee Valley Amateur Radio Network will hold its 8th annual Hamfest and Computer Show at the Gallatin Civic Center. Setup Fri. 5–9 p.m., Sat. 5–8 a.m. Open Sat., 8 a.m.–2 p.m. Tables $10. Adm. $5, XYLs and under 16 free. Talk-in on 147.90/.30 T 114.8. Food available. Free parking, handicapped accessible. VE exams by pre-registration only. Send 610, copy of license or certificate of successful completion, and an SASE to *Ronnie Gilley, 512 Hillside Dr., Gallatin TN 37066.* For hamfest info, contact *Bill Ferrell N4SSB, 1253 Woodvale Dr., Gallatin TN 37066;* or *phone (615) 451-5992* and leave a message.

JAN 25

VILLA PARK, IL The Wheaton Community Radio Amateurs will hold their 31st annual midwinter Hamfest on Super Bowl Sunday, Jan. 25th, 1998. It will be held at the Odeum Exposition Center, 8 a.m.–2 p.m. Tickets are $6 in advance (with four prize stubs), or $8 at the door (with one prize stub). Advance tickets may be purchased by sending a business-size SASE to *WCRA, P.O. Box QSL, Wheaton IL 60189.* Free off-site parking and bus service is included in the ticket price. All flea market tables by reservation: please call *(630) 545-9950.* For commercial area info, call *(630) 545-9950;* or fax *(630) 629-7098.* Talk-in on 145.390(-). VE exams will be held on-site.

SPECIAL EVENT STATIONS

DEC 6

IOWA CITY, IA The Iowa City ARC and the University of Iowa ARC, will operate station WØIO on Dec. 6, 1400Z–2300Z, to celebrate the 150th anniversary of the founding of the University of Iowa. The station will operate within 20 kHz of 7.250, 14.250, 21.300 and 28.400 MHz. For a certificate, send QSL and a 9" x 12" SASE to *Jon Poulton WØCK, 729 Alpine Drive, Iowa City IA 52245 USA.*

DEC 6–7

MESA, AZ The East Valley Amateur Radio Group will operate WA7USA from 1500Z–2400Z to commemorate the battleship *USS Arizona*. Frequencies will be 14.240 MHz and 21.340 MHz. Stations contacted may request a certificate by sending a QSL card and a 9" x 12" SASE to *EVARG, 3264 E. Carol Ave., Mesa AZ 85204-3245 USA.*

DEC 12–13

BETHLEHEM, IN The Clark County ARC will operate W9WWI, 1500Z Dec. 12th–2200Z Dec. 13th., in celebration of the Christmas season. Operation will be on General 75, 40 and 20 meters. QSL with an SASE for a certficate, to *CCARC, 1805 E. 8th St., Jeffersonville IN 47130 USA.*

DEC 13

KENOSHA, WI The Lakeshore Repeater Association, in cooperation with Carthage College, will operate a special event station in the Todd Wehr Center at Carthage College. The station will operate 1500 UTC–2100 UTC on 7.125, 28.335, 50.15, and 146.520 MHz, using the callsign N9LTA. Operation will be to commemorate Carthage College's Sesquicentennial. Additional information will be available during the event.

DEC 13–14

BETHLEHEM/NAZARETH, PA The Christmas City and Delaware-Lehigh ARCs will operate station WX3MAS, 1400Z–0200Z on Dec. 13th and 14th, as the annual Christmas City event. Frequencies: SSB—3965, 7265, 14265 and 28365 kHz; CW—45 kHz from the band edge on 80/40/30m. For a certificate, send QSO info and SASE to *DLARC-WX3MAS, RR4 Greystone Bldg., Nazareth PA 18064-9211 USA.*

DEC 31

FULLERTON, CA The Fullerton Radio Club (CA) will operate a First Night special event station in the booth area of Fullerton's non-alcoholic celebration of New Year's Eve. The club station, W6ULI, will be operated on phone 00:30 UTC–07:30 UTC. Frequencies to be used will be close to 7.25, 14.33, 21.33, and 28.40 MHz. For an 8-1/2" x 10" certificate, send an SASE to *FRC, P.O. Box 545, Fullerton CA 92836.*

JAN 10–11

1998 HUNTING LIONS IN THE AIR CONTEST The 26th annual Hunting Lions in the Air Contest will take place 0900 UTC Sat., Jan. 10th–2100 UTC Sun., Jan. 11th, with the objective of creating and fostering a spirit of international understanding and cooperation among amateurs and Lions, through worldwide communication. The contest is to commemorate the birthday of the founder of Lionism, Melvin Jones, born at Ft. Thomas AZ, USA, on Jan. 13, 1879. Operators interested in additional info regarding this contest should write to *Contest Committee, Lions Club Flen, Box 106, 642 23 Flen, Sweden.E-mail [goran.blumentahl@swipnet.se].*

JAN 28

SAN DIEGO, CA The Challenger Middle School ARC, KI6YG, will operate a special event station to commemorate the 12th anniversary of the space shuttle *Challenger* tragedy, 1500 UTC–2400 UTC, on or near 14.250, 21.350, 28.350, and 146.52 simplex. QSL to *Challenger Middle School ARC, 10810 Parkdale Ave., San Diego CA 92126 USA.*

NEVER SAY DIE

Continued from page 45

we're either going to change it, despite the fierce opposition of the educational unions, or we're going to suffer.

Or we can continue as we have, ignoring the problem and sedating ourselves with fast food, beer, and amusements, and let our kids worry about the mess they've inherited through our neglect.

Have you read *any* of the books about the Sudbury Valley School yet? About the mess our colleges are in? Or are you out there parading mindlessly with a poster expressing your anger over your job being moved to Mexico or Malaysia?

Hey, let's hope that some chap doesn't get the bright idea to start educating the millions of people in Africa! The problem with knowledge is that it can be taught to anyone. I've already mentioned that more and more of the Silicon Valley software meetings are being held in Chinese.

Birth Defects

While watching the news, I saw pictures of crews spraying to kill mosquitoes around Orlando's Magic Kingdom™. That took me back to when I worked at WSPB in Sarasota as an engineer-announcer. I had the morning shift, so it was my job to get there early in the morning to put the station on the air. But at any time of the day, getting from my car to the station meant a 10-yard dash through the mosquitoes and then beating a bunch off after getting into the building. And this despite daily aerial spraying of the whole area.

So what's all this got to do with birth defects? Well, I was reading recently that the incidence of birth defects has been increasing, with the curve sloping sharply upward. And that, in turn, got me to thinking that a birth defect has to be pretty severe before it's visible to the eye. 99.9% of birth defects are not visible. They're things like a lowering of IQ, potential later mental problems, autism, attention deficits, hyperactivity, emotional instability, and so on.

But below that are 99% of the invisible defects—which will tend to be passed along to their children.

So what causes birth defects? Just what you'd expect. Anything which can alter the mother's or father's genetic material. Scientists have agreed that nicotine, caffeine, and alcohol before conception often do cause birth defects. As do cocaine and other drugs. And it's fair to indict other poisons we breathe, eat, drink or inject into our bodies. And that includes the stuff food processors use to retard spoilage or color our foods, hormones fed or injected into animals to improve meat or milk production, and so on. Plus poisons sprayed on fruits and vegetables to keep away insects.

Having a child today is one heck of a crapshoot. And keeping yourself away from all these poisons is nearly impossible. They're in the air, our water, our food, and immunization shots, and they're very difficult to avoid.

Worse, through the overuse of antibiotics in people and animals, diseases are mutating so they are resistant to all but the newest antibiotics. I'm hoping that silver colloids will be an answer to this, but the inability of the pharmaceutical companies to patent it and charge us a fortune for it probably means that they, aided by the AMA, FDA, and on through the medical alphabet, will fight to the last ditch to prevent it from even being tested.

But colloidal silver does seem to be a way to kill off the bad bugs, and one the bugs can't adapt to.

Even if some doctors do bona fide research on the effectiveness of silver, I guarantee that their results will not get published—because the medical journals are all funded by the pharmaceutical giants.

There isn't much you can do about this directly, but you can do your best to keep your poison input to a minimum. And women can take extra precautions before and during pregnancy.

Takes All Kinds

Well, hams made the papers! There was a story in the *Elkhart Journal and Courier* about a local repeater being jammed by beach balls. It seems that the repeater group somehow managed to irritate a creative ham enough so he has been building little transmitters, putting them into beach balls and leaving them on the Elkhart River shore.

The repeater group is frustrated because the FCC doesn't seem interested and the State Police say no state laws have been broken.

Paparazzi

Yes, they're sure a nuisance to the famous, and they contributed to Princess Di's death. But before dumping a big bunch of blame on these scavengers, let's look at the whole food chain that makes them possible.

The reason these guys go to such lengths to take pictures of the famous is that the tabloids will pay huge amounts of money for the pictures. That makes it worth all the effort and time it takes to get the pictures.

The tabloids pay big money for the pictures because they sell more papers, making the

Continued on page 85

Affordable Antenna Project for APRS

Build an external antenna for your GPS receiver.

Frank Kostelac N7ZEV
4233 W. Warmsprings Rd.
Las Vegas NV 89118

If you're into APRS (Automatic Packet Reporting System), you've no doubt discovered the need and expense of a remote antenna on your hand-held GPS unit. We discovered that a 1.5 GHz helix wound on a piece of PVC makes an excellent magnetic-mount GPS antenna.

The challenge is to turn a plastic egg (from the lingerie drawer) and a two-inch-long piece of 3/4-inch PVC (the type used to put in sprinkler systems) into a serviceable antenna for the state-of-the-art Global Positioning System operating in the 1.5 GHz portion of the spectrum. **Photo A** shows what it can look like using an egglike pantyhose container. However, my wife informs me these are no longer available, so we have made some very colorful units from smaller plastic containers that were sold to put Easter candy in. By the way, just about any plastic container with a flat lid and an RF-transparent bowl can be used.

A chrome egg is another possible variation on the housing.

Once the chrome is scrubbed off with a scouring pad (a standard kitchen scrubber will work fine), the next challenge is to configure a mounting. A snap-off jelly jar lid (we used Welch's™) and three Radio Shack™ magnets can be glued together using a tube of clear silicone. The result is quite presentable and affordable.

Use one-eighth-inch-wide, adhesive-backed copper foil (printed circuit board repair foil). Two pieces (each about five and a half inches long) are attached to the form to make a helix arrangement. Mark the PVC at 90-degree intervals on both the top and bottom, and then attach the copper foil so as to get a twist between top and bottom. The tape used was printer circuit repair foil, but I have been using half-inch-wide tape that I was able to cut one-eighth-inch strips from. The tape is not critical, but the ability to solder it to the ground plane and to the coax is.

Next, solder the ground plane by soldering the four points of copper-to-copper contact at the bottom of the form.

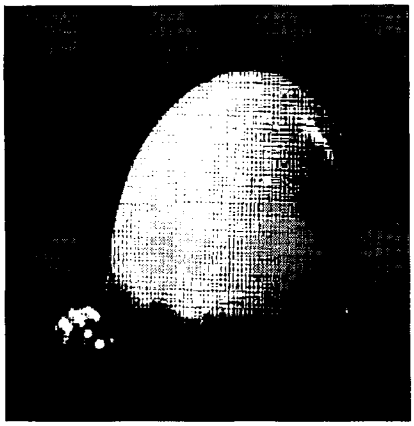


***Photo A.** The chrome is removed, and the egg, a jelly jar lid, and three magnets are glued together with clear silicone.*

Affordable APRS Antenna Project
1 4 cm x 4 cm piece of copper foil (for the ground plane)
12 inches of printed circuit repair foil (1/8-inch wide)
1 section 3/4-inch PVC (2 inches long)
1 egg-shaped radome (or any plastic container that is RF-transparent and large enough inside to accommodate the 2-inch-tall helix)
1 length of RG-174 coax (the shorter, the better at these frequencies)
3 quarter-sized round magnets (Radio Shack™ Part# 64-1888 or 64-1879)
1 lid that matches the radome diameter (plastic or metal)
1 connector, appropriate to your GPS

***Table 1.** Parts list.*

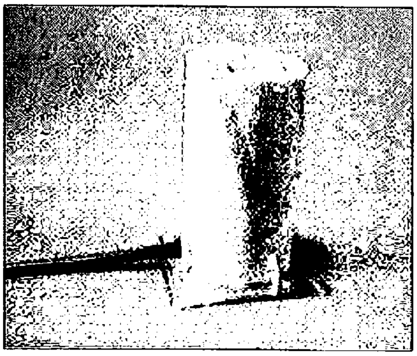


Photo B. With the helix formed on the PVC, the ground plane is attached. A hole in the PVC is left for the RG-174.

The ground plane itself is copper foil cut to 4 cm by 4 cm square. Then, drill a hole into the form near the bottom to allow the RG-174 to enter the form.

The center conductor and shield are each soldered to one of the foils running across the top of the PVC form. The completed antenna is then siliconed to the lid and the "radome" is siliconed over the antenna with a notch cut for the needed coax clearance. If you use Easter eggs or some other container this can get a little more complex, but it's still manageable.

A kit of materials is available for $25.00 plus shipping from the author. Write to Frank Kostelac, 4233 W. Warmsprings Rd., Las Vegas NV 89118. Only money orders will be accepted, and the kit will be shipped COD. Please allow about 6 weeks for delivery, as the parts will be gathered once a response is determined. The connector is not included. And the radome will be the author's choice.

Photo C. The center conductor and shield are soldered to separate helix foils running across top of PVC, before entire PVC assembly is siliconed to jar lid and sealed.

Number 50 on your Feedback card

Abode & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119
E-mail: [clhough@pacbell.net]

Stocking the amateur junk box

How do you stock an amateur junk box with component parts—or, more importantly, where do you go to get the stuff to stock a junk box *with*? We are all collectors, but some of us have difficulty in locating materials cheaply.

How do you determine what parts should be on the "critical" list to start building your junk box? How complicated a system should you use in trying to sort the components you have collected? What method of storage should you use to store spare parts?

These are some of the questions that I run into time and again with new amateurs. There's no one best answer, but I guess the foremost thing to cover is the main motive that thrusts us into the arena where a junk box is deemed necessary.

Amateur radio operators or just plain electronics hobbyists all have one thing in common—we want to construct our electronic projects, and more than anything else, we want them to be economical.

In this drive for economical projects, one thing is paramount: A junk box makes it possible to experiment or build projects from a home stock of component parts.

First, let's define "junk box." Contrary to what your non-amateur spouse may say, there is no "junk" in a junk box—it's all precious stuff! Now, "stuff" is all the material we haul home and expect to rebuild or convert from obscurity into a full inspirational home-brew whatever. Translating that into standard text (spousal translation) traditionally means taking a pig's ear and turning it into a silk purse.

Well, as far as I'm concerned, they never took rosin into the equation. From all evaluations this is the substance that I am hooked on. Many boxes of stuff were constructed with rosin going up in smoke as burnt offerings. I have constructed quite a few ugly boxes, and in the process of constructing them, I have made many mistakes—but have also learned a lot.

I volunteered my services as small parts bank manager in the Navy MARS program while assistant to the director of the 11th Naval District. I served in the capacity of small parts bank manager to the District (five western states). Now, that was a sorting job in itself but it taught me many things.

The most important thing is that whatever you haul home to add to a junk box, don't let it turn to clutter or get lost. If you don't use it or find a new home for it within, say, a year, get rid of it. The idea here is that you do not have vast storage space. What you do *not* want to get rid of is a selection of commonly-used parts like a good basic resistor and capacitor assortment.

Add to this basic beginning diodes and transistors, not just trying to collect every 2N part number, but useful things that you might need. For sure, you'll need rectifier diodes in low and high voltage applications and basic low-power signal NPN and PNP transistors. If you're going to build preamps, try to find FET or JFET devices to add to this junk box.

Now the big question: Where do you locate parts? Well, I have taken advantage of swap meets and surplus sales to collect components for use. PC boards with exotic parts can be obtained at many swap meets at inexpensive prices. The cost is low, as parts have to be unsoldered to remove them, making reclaiming components a time-consuming venture.

There is hope, however—but you have to have eagle eyes to pick the better boards from the *real* junk boards. Computer PC boards and TV boards don't have much in the way of premium parts for amateur projects. Look for boards that were used in synthesizers and RF applications like cable TV converters. See **Photo A**. Look (eagle-eyed) for component parts that are soldered without their leads being bent to hold them on the PC board. Leads that are not bent when inserted on a board are easier to remove.

Pick up catalogs and other literature, and become familiar with the color codes and markings of component parts. This will allow you to better recognize what you are looking at on a raw PC board. Sometimes it will not be obvious what the board was used for; don't waste time trying to figure it out. Of course, if you happen to have

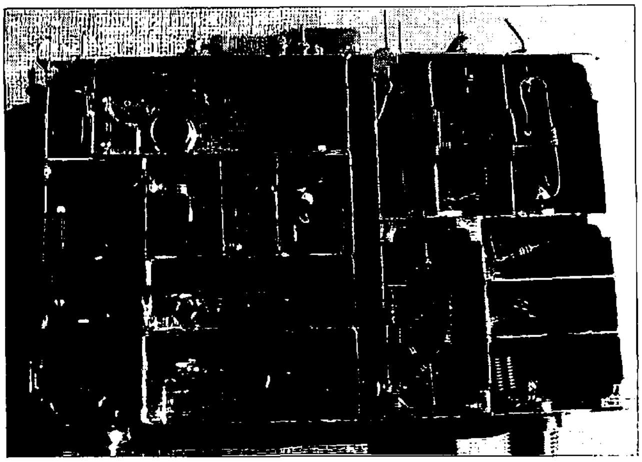


Photo B. *Lots of parts in a cable TV tuner, a great home for many RF components. Besides a VCO (voltage controlled oscillator) and a DBM (double balanced mixer) there are several varactor diodes.*

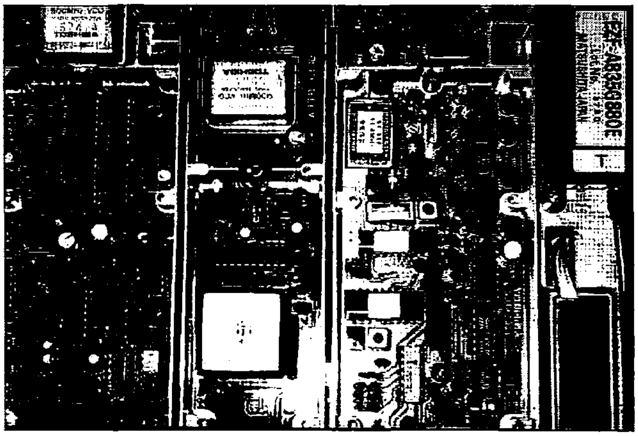


Photo A. *Parts are where you find them. This photo shows some of the PC boards for an 800 MHz older large-style cell phone. At only \$2, it provided a crystal reference oscillator, two VCOs, a great 900 MHz RF preamp and several good chip ICs for future use.*

several of a particular type of PC board, then investigate what can be done to convert it (or a portion of it) to a helpful amateur application.

When you have a small pile of PC boards that make better candidates for parts removal, remove, individually, the parts you want to save that would be damaged by high heat. Plastic-wrapped electrolytics and some plastic-insulated coil forms need to be removed with a soldering iron, something that will be soon be evident if you want to save the part.

Why? Well, because we will re-flow solder over the entire board at one time—with a big re-flow soldering machine which we will construct to unsolder the entire PC board at one time. Sound unbelievable? It's true. What you will use for desoldering the PC board is an inexpensive charcoal BBQ. Be careful using this technique, and follow safety procedures.

I use a full-face shop mask and cap, long-sleeved shirt, heavy shop apron with gloves, and a long pair of pliers or tongs to put the board in a BBQ. Use similar tools when lifting the board back out of the BBQ and don't skimp on safety protection. Wear safety glasses, or even better, use a shop shield that protects your whole face. You are dealing with hot melted solder and you need the protective clothing and protective gear. *Do not attempt this without protective gear!*

I use an inexpensive small round BBQ grill for charcoal cooking. Make a round metal "grill" or use the one provided and redress its diameter. You want the grill lowered in the BBQ itself to give some protection from air drafts directly on the PC board. This promotes fast and even heating of the PC board. And you want this grill about an inch above the charcoal and an inch or two below the top surface.

When the BBQ charcoal is ready (fully burning coals), you're ready for a session of desoldering. Don't forget the protective gear. Prepare a cardboard box with a lining of newsprint. This is your parts depository and the newspaper serves as a target on the side of the box. The object is to heat the board till the parts are unsoldered without burning the board. This takes about a minute or two and then, carefully, in protective clothing, remove the board with the long pliers or tongs, hold the board vertically and tap it, shaking the parts towards the box and newsprint. If all is well the parts will come off (unless the leads are bent).

The parts fly off the unsoldered board onto the newspaper and slide down to the bottom of the box. Give the parts a little time to cool, then transfer them to a storage box. Separate the solder droplets and parts later. If the parts are not removed from the box bottom they will be covered with solder droplets when you do the next board.

Things to watch out for are overheating the board and burning the epoxy. Use the safety precautions outlined. Perform the operation when you have a controlled environment, such as no pets or children, and can work safely.

Whatever method you use to obtain parts, be it the desolder method or purchasing parts at a swap meet, store them in a see-through plastic box to make finding them easier. I have used the large parts cabinets before, but they work better for more aggressive builders who need a generic assortment of IC and transistors readily at hand. The cabinets are nice, but unless you are ready to start a developmental electronics shop, a small shop see-through bin is better and easier to store in a apartment or limited storage space. An alternative is to use small coin-type envelopes to put parts in (**Photo C**).

Sort items that will be used heavily, like resistors, by the last color band. In this way, with black as the last band, all resistors in value from zero to 100 ohms will be in this sort bin. Continue for other colors: brown, red, orange, yellow, green, blue, violet, gray, white. In an average sort, the lower six colors representing zero to 10^5 as a multiplier will be heavily used, so prepare good-sized boxes or bags for a large quantity of them.

When you have your parts removed, the sorting begins. I usually pick the largest components out first and separate them into generic categories such as large resistors and transistors. Pick up some see-through small plastic boxes to sort parts that are smaller. A simple multiple bin can be a plastic egg holder. Sort resistors by the last color code band, which is the multiplier. In this way, I only have ten compartments to sort resistors in. Bin one is 0 to 100 ohms or color code "black" with bins two through seven for colors brown, red, orange, yellow, green, and blue. Bins eight, nine, and ten are for extra space and would be such very high values you might not normally see many of them.

The same works for the capacitor bin. Sort them to basic value, such as coupling in the low ranges of pF—say, 10 to 100 pF and 100 to 1000 pF or .001 µF. Keep going with capacitors in the .01 and .1 µF ranges. Next come the electrolytics and high-value µF capacitors. Use the same sorting techniques as with the resistors. If you have large components that do not lend themselves to the snap parts box use a shoe box and some envelopes. Write the component part name on the tops of the envelopes and store them upright to make locating easier.

How you arrange your junk box must be structured on what your interests are. If you are into QRP projects you will slant the remaining space to low-power RF transistors and crystals in the amateur band, and variable capacitors to tune circuits to resonance. Don't forget the variable pots (potentiometers). I store them separated by low values under 1k, under 10k, 100k, and 1 meg. LEDs, knobs, nuts and bolts, and all other kinds of bits and pieces fill out the boxes.

What advice, out of all of this, have I taken to heart? Well, "keep the peace in the family" is the most important thing. Don't haul home the entire 35-inch TV to strip parts from—too much junk to get rid of. Shop smart and be parts savvy. Keep track of how much chaff you will have to get rid of compared with how many good component parts you can recover.

Continued on page 52

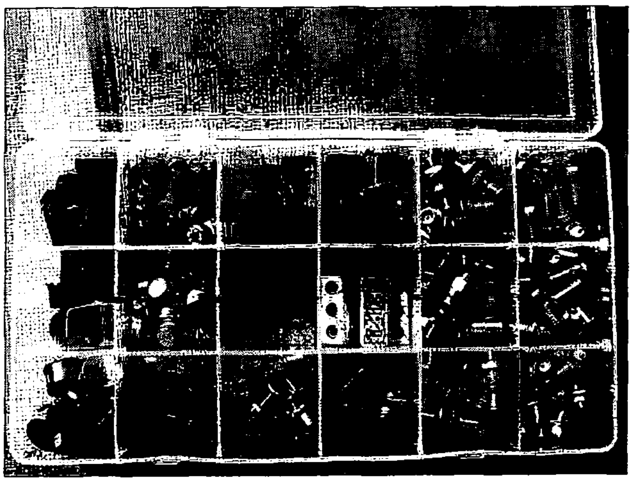


Photo C. *Plastic parts box used for see-through storage. Don't put them in a cardboard box as small parts get lost fast and are not worth keeping unless you can locate them when you need them.*

Number 52 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More transmitters

Last time, we were exploring RF signal generation. Let's continue:

As I mentioned, class C amplifiers, which act as nonlinear switches, are considerably more efficient than linear amplifiers, so we use them as often as we can. Some modes, though, can't use such amplifiers—most notably, SSB. SSB is a lot like AM, so why can't we use a class C amp? After all, we saw how class C could make fine AM, even though the final signal required linearity. Essentially, the final amp is used as the modulator. But simply modulating audio onto a carrier creates double-sideband AM, like it or not.

That's the "natural" form of amplitude modulation. To get SSB, extra steps are required.

We use SSB for several reasons: It uses half the band space per station, it eliminates heterodyne interference, and it takes *way* less power to get the same readability at the receiver. The biggest reason we like it, though, is that SSB puts all the power into the information we want to send, without wasting any on a needless carrier or a duplicate sideband.

Getting a radio signal to do such tricks requires some processing. Essentially, you make a double-sideband signal first. You could do that with an AM modulator, but there's no point in doing it that way, since you'll be throwing away the carrier anyway. Besides, some of that carrier might leak through the filter. So a balanced modulator, which outputs two sidebands but no carrier, is used instead. Balanced modulators are surprisingly easy to make; you can do the job with four diodes!

Once you have your double-sideband signal, you then strip off the undesired sideband with a frequency-selective filter. That can be made from a few crystals or a ceramic filter. What's left is one sideband completely dedicated to your modulation. Then, you amplify it and out it goes! (In a real radio, the SSB signal is often mixed with another oscillator first, to put it on the frequency you've chosen.)

Since the SSB signal contains varying amplitudes which represent important aspects of your modulation, you can't send it to a class C amplifier that's going to clip the waveform or otherwise distort it. Such distortion would result in splatter and very ugly audio, not to mention out-of-band harmonics and garbage that just might earn you a free ticket—from the FCC. So, all amplifiers following the generation of an SSB signal have to be as linear as possible.

Still, what would prevent us from using the final amp as the modulator, just as we did with AM? That way, we could indeed use a class C amplifier. Well, it would work, but it would be incredibly wasteful. Essentially, we'd be making lots of RF power and then throwing it away! To throw away power, of course, means to turn it into heat. There are easier ways of heating a room. Just for fun, though, let's look at how it might be done:

To create final-amp SSB generation, we would first make an oscillator and feed it to the amp, just as if we were going to do CW or AM. We would then modulate the amp's DC power supply, as with AM. The result would be regular AM, which we'd then turn into SSB via a filter which would remove the carrier and the opposite sideband. Considering that we'd be throwing away about two thirds of everything we made, that had better be a pretty big filter, though—capable of taking some power and dissipating some heat! The result would, indeed, be perfectly acceptable SSB. To get it, though, our power supply and amplifier would have to be as big and power-hungry as if we were sending regular AM. The only thing gained would be the reduction in spectrum use.

And now you know why nobody does it that way! By doing it at low signal levels and then linearly amplifying the result, much greater efficiency is obtained, even though the amplifier itself is less efficient. After all, with low-level modulation, we're only throwing away some fraction of a milliwatt, and we don't need nearly as big a power supply for the amplifier, either, because it isn't handling a carrier and only needs peak current during modulation peaks.

Multimode rigs which can do both AM and SSB generally create the AM at a low signal level and amplify it linearly, as if they were creating SSB. Heck, the linear amp is already there, and switching from SSB to AM requires little more than unbalancing the modulator (so the carrier can pass) and removing the sideband filter.

Other TX modes

We use many modes besides voice. How do they fit into the scheme of things as far as transmitters are concerned? SSTV is actually a form of FM, even

Above & Beyond

continued from page 51

How have I sorted parts in my shack? I have a small photo darkroom in my garage that doubles as my Fibber McGee's Closet. I have constructed shelves that go to the top of the eight-foot darkroom ceiling. I use small cardboard boxes with envelopes, sorting out a selection of resistors in the chip, 1/8-watt, 1/2-watt, and precision types. Capacitors are similarly stored with small chip-types and variables in the bin-type multi-compartment see-through boxes I mentioned before.

The work bench is similarly equipped, with more junk storage space, topped off with a small section of half-inch pipe on top, which holds wire spools of different colors of wire for hookup use. Nothing fancy—just practical. Large materials, like coaxial cable and such, are in the cable locker outside, in a small tool shed where the spiders reside.

It takes time to organize the materials and you have to keep at it. It makes no sense to store material unless you can locate it later. If you have to dig in an endless series of boxes to find that choice part, you might as well not store it. Mark boxes on several sides as to what their contents are. Keep like items together. This makes it easier to locate later when you have almost forgotten where it is or where you put it. It's with the other similar wombats and the box is marked.

I have enclosed several photos of my shack and its storage facilities. You do not have to go to such extremes, but if you are a parts junkie like me you will put something together that absorbs space like a race horse. Whatever you put together, keep these three rules in mind:

1. Don't haul home very large items.

2. Don't accept everything unless you have a very large trash dumpster.

3. Store parts with others of the same type, for easy location when you need them.

The time spent collecting and storing parts is meant to aid you in the construction of a favorite project or a PC board—not create a storage monster. 73

though it's carried on an SSB channel, at least on the HF bands. The information for the brightness and color of each dot in the picture is modulated onto an audio tone by wiggling its frequency around. The audio tone, essentially, is the FM carrier. That tone is then modulated onto a radio frequency carrier using SSB. The result on the air is FM.

Why? When you send a pure, sine-wave tone into an SSB transmitter, the output is a pure carrier whose frequency is offset by the frequency of the tone. So, as the SSTV's audio tone moves around in frequency, so does the transmitter's RF signal. But how can an SSB transmitter have a carrier in the first place? As far as the transmitter is concerned, it is sending modulation, not its *own* carrier. It just looks like a carrier to everyone else! Digital data can be sent in many ways. Most often, though, it's sent much like SSTV, except that the audio tone has only one of two states: up and down. So, instead of calling it FM, we call it "frequency shift keying."

It's still FM

This quite naturally leads to the question of whether SSTV and data, such as RTTY, packet, or AMTOR, could be sent using a nice efficient class C amplifier. The answer is yes! We don't usually do it that way because we want to use our existing SSB rigs, which are intended primarily for voice operation. There's no reason, though, why a dedicated rig couldn't be built using class C. Such a rig wouldn't be useful for voice, but it would work great for SSTV and digital modes. I've long fantasized about making a QRP RTTY rig and using it with a palmtop computer, such as my Apple Newton, in the middle of nowhere. Oh, if I only had the time ...

Transmitter oddities

Way back at the beginning of this transmitter mini-series, I mentioned the issue of Q, or "quality factor." Essentially, Q indicates how efficient and resonant a tuned circuit actually is, and is expressed as inductance divided by resistance. In other words, the more inductance and less resistance a tuned circuit has, the higher its Q.

A tuned circuit acts something like an auto-transformer, in that it converts current to voltage. How? The incoming AC current is stored in the inductor's magnetic field, which then collapses as the incoming power reverses direction. The collapsing field cuts through the inductor's turns, making it generate a voltage. It's quite possible to wind up with voltages considerably higher than what you started with! Of course, you haven't created power from nothing, since the output current is reduced by the same ratio as the voltage increase.

Can you have too much Q? Yes, you sure can! With the buildup in voltage comes the prospect of doing some circuit damage. For instance, if you start with 12 volts of DC, and your transistors are rated at 18 volts, you should be OK, right? Sorry. If the tuned circuit converts that to 24 volts of RF, you'll fry that transistor. Similarly, capacitors and other components must be able to withstand the peak voltage created by the tuned circuit. Also, excessive Q can make enough voltage to interact with other components in an unstable manner, causing ringing or even unwanted oscillations not on the intended frequency.

Unfortunately, you don't always know what that voltage will be. Especially in the "tank" of a transmitter, the voltage you wind up with has a lot to do with the SWR of your antenna. If it's too high, the antenna won't accept the RF power, and the voltage across the tuned circuit will rise as the reflected power comes back. That's why you see zener diodes across the outputs of some solid-state RF final amplifier stages—the diodes break over and shunt the excess voltage to ground, protecting the transistor. At least, that's how it's supposed to work.

Letter time

Dear Kaboom,

I have an early HF rig that keeps blowing its finals! These things aren't cheap, and I'm tired of replacing them. What gives?

Signed,
Zap 'n' Poof

Dear Zap,

Early designs were much more subject to this sort of thing than the stuff we have today. Partly, it's because the early transistors just weren't very sturdy when used for RF—their junctions broke down easily under excessive peak voltage. See if there's a more modern cross for the parts you've been using. Plus, some designs were marginal, pushing the transistors to their limits. (Designers were used to tubes, which could more easily take it, and old habits die hard.)

Also, it could be that you have a bad filter cap on the DC line which is allowing RF feedback and spikes to occur. Remember, it's the voltage across the three elements of the transistor that determines whether it lives or dies, not the voltage to ground. If there is feedback or spikes, they can add to the output voltage and exceed the breakdown voltage of the transistor's junctions. Check the bypass caps near the transistors themselves. Finally, make sure the power has someplace to go. If your SWR is high, or some bad part is blocking the power between the transistors and the antenna, that'll do it, too.

Until next time, 73 de KB1UM.

Number 54 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
[Homingin@aol.com]
[http://members.aol.com/homingin/]

New sporting goods for foxhunting

Looking for a great way to get young people interested in ham radio and electronics? Take them out to hunt hidden transmitters! What better way is there to hook them than the adventure, mystery and challenge of locating the source of signals with radio direction finding (RDF) equipment?

In dozens of nations around the world, amateur RDF (called foxhunting, radio-orienteering and ARDF) is a popular sport for youth. Events in these countries are similar to orienteering competitions. About half a dozen low-powered transmitters (foxes) are concealed throughout a large park or forest. They transmit one at a time, in numbered sequence, on the same frequency. Contestants see how many they can locate in a prescribed time period, usually about two hours.

Radio-orienteering has been most popular in eastern Europe, China, Japan and former Soviet Union countries. It's now catching on in North America. Of course, you don't have to have formal championships just so the kids in your school, club or Scout group can enjoy the fun. All you have to do is scatter some little two-meter transmitters in a park, give 'em some gear and turn 'em loose!

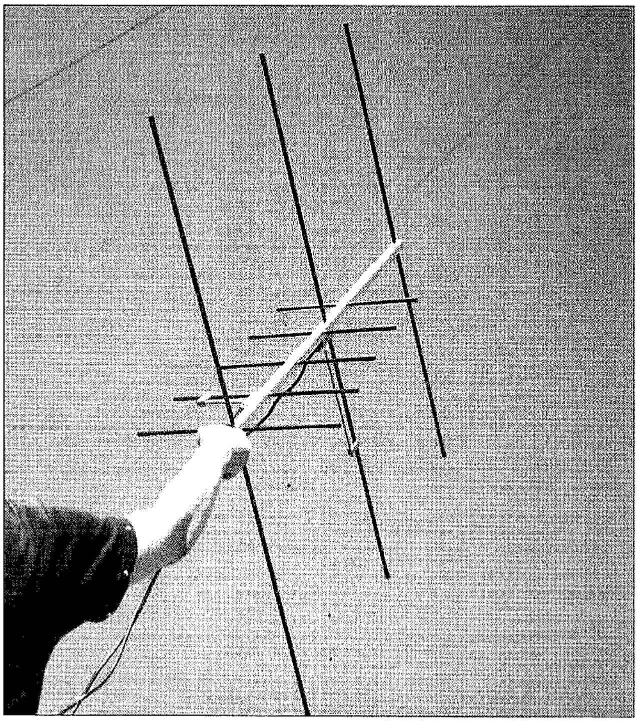


Photo A. *Besides RDF on 146 and 440 MHz, you can use a dual-band Arrow yagi in a portable satellite station for OSCAR modes B and J, as shown here.*

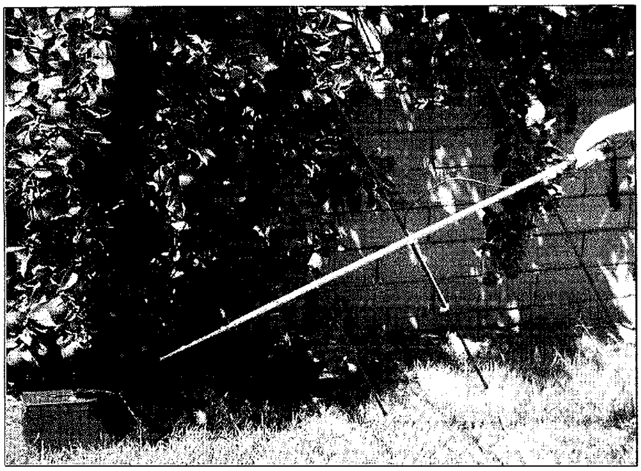


Photo B. *The SAR2 155 MHz yagi and SAR's two-meter version look almost the same. They provide both improved communication range and RDF capability.*

What gear?

In general, the better your equipment, the more fun you'll have. Ordinary handie-talkies and scanners will get you started on two meters. Simple techniques such as body shielding provide useful bearings under most circumstances. A directional gain antenna makes bearings more accurate and helps detect and track very low-power foxes. Yagis of two to four elements are a popular choice.

Grade school kids won't think it's fun to hold a heavy object as they walk in the woods, so a yagi should be as light as possible. Arrow Antenna™ yagis have elements made from aluminum arrow shafts. Such elements are quite strong, but are about half the weight of an equivalent piece of ordinary tubular aluminum (**Photo A**).

The latest Arrow product is the Model 146/437-10. It has three two-meter elements and seven 70 cm elements on the same boom, with separate gamma matches and feedline terminations. You can track a two-meter signal on its fundamental, then quickly switch to the third harmonic as you close in, when the fundamental overpowers your receiver. The price of this 19-ounce dual-band yagi is $73. Single-band models are also available, starting at $49 for three elements on two meters, weighing 15 ounces. For more information, contact Allen Lowe NØIMW at Arrow Antenna, 1803 S. Greeley Highway #B, Cheyenne WY 82007; tel. (307) 638-2369.

A new entry into the lightweight antenna market is Super Antenna Resources (SAR), run by Paul Andreasen K1JAN and Carl Calos KE6CCV (**Photo B**). Their primary product is the SAR2, a 155 MHz three-element yagi built on a 54-inch tapered aluminum boom that doubles as a walking and tracking stick. It weighs 15 ounces and costs about $70. The gamma match assembly is pre-tuned for easy assembly in the field.

Cabco Industries, manufacturer of SAR antennas, welcomes custom orders for beams from 84 to 940 MHz. You can get a yagi without the long boom tip for T-hunting, or with a square boom for fixed-station mast mounting. For more information, write to SAR, P.O. Box 2610, Lompoc CA 93438; or call Cabco at (805) 736-0662 and ask for Carl.

For use by kids and adults in woodland foxhunts, a yagi's boom should be no longer than necessary. The photos show yagis being held by the supplied hand grips on the boom ends, but it will be easier for children to use them if you attach a mast

of PVC pipe to the balance point on the boom. With it, they can carry and rotate the antenna like a flagpole in a parade.

Caution: Eye protection should always be worn when running or walking with a VHF beam antenna.

A signal strength indicator (S-meter) is an important feature to have on the receiver you use for on-foot foxhunting. You'll also want to have a way to reduce signal strength as you approach the fox, to prevent receiver overload and help you take close-in bearings. Offset-type RF attenuators work best for on-foot two-meter RDF. More information on them is in recent editions of *The ARRL Handbook* and "Homing In" for July 1994.

All in one

Championship foxhunters know that a receiver/antenna combination with good directivity, a wide range RF gain control and an accurate strength indicator makes them more efficient and proficient. It's also much easier for beginners to track signals using such a one-piece integrated device.

In every country where ARDF has high participation, special RDF receiver/antenna sets, kit or factory-built, are readily available. Some of them, such as the Altai-144 from Russia, lack the selectivity to perform well in crowded US band conditions. Mizuho in Japan makes an excellent ARDF set, but its price approximates that of a dual-band handie-talkie. Foreign built/tested ARDF sets are not sold widely in the USA because of the small perceived market and the cost of mandatory FCC Part 15 receiver certification.

New "single chip" circuits make it possible to produce small VHF receivers with excellent sensitivity and selectivity at modest cost. So far, no US manufacturer has put a set with special ARDF features, such as audio S-meter and wide-range attenuator, into its product line, but a good one is available "Down Under." It's made and sold in kit form by Ron Graham Electronics (RGE). Ron VK4BRG welcomes stateside orders.

Photo C shows the complete receiver (Model RX-1) and antenna (Model ANT1/144) combination. The 11-ounce antenna features the classic HB9CV design with two driven elements spaced ten inches apart and fed out of phase so that the directional pattern is cardioid (heart-shaped). In other words, it has one forward gain lobe and one null in the back. Ron's design is optimized for best pattern (front-to-back ratio) at the expense of some gain reduction. The compact spacing of a two-meter HB9CV antenna makes it a popular choice among ARDF champions around the world.

For crashing through the brush, many foxhunters prefer antenna elements of curved steel tape that give way to foliage and snap back into place. Long elements of tape do not retain shape well, so the RGE beam has elements that are half rod, half tape. This is a good compromise. The flexible ends are covered with tough sleeving. They screw onto and off the rods for easy disassembly and transport.

The RX-1 is designed around the Motorola MC3362 dual-conversion receiver IC. A dual-gate MOSFET in the front end makes this a "hot" receiver; mine achieved 0.1 microvolt sensitivity. An LM386 audio driver provides plenty of sound in the headphones. The wide range (more than 100 dB) RF gain circuit controls Gate 2 of the MOSFET and stages within the MC3362. It can knock down a 350,000 microvolt signal enough to get a good bearing.

Instead of a panel S-meter, which is relatively fragile and difficult to watch while navigating through the woods, the RX-1 has a tone-pitch S-meter mode. As signal strength increases, the tone goes from a low growl to a high whine, then to supersonic frequencies. Australians call this the "whoopee" mode because of the whooping tones the user hears while sweeping the beam across an incoming signal.

The receiver kit includes all parts including the double-sided circuit board and a 4-3/8- by 2-3/8- by 1-3/16-inch aluminum box with all holes pre-drilled and tapped (**Photo D**). Labeling of the controls is done simply with two printed overlays, each with a clear plastic cover. It's not as elegant as dry transfer lettering or engraving, but the marks are very easy to read. If you seal the edges of the clear covers, you won't have to worry about rain or wear erasing the lettering.

Although not step-by-step for each part, the kit's instructions are readily understandable. A VHF receiver like this is probably not a good first project for someone new to electronics, but if you have a couple of successful kits under your belt or if you have an experienced Elmer to help you, there should be no problem building and testing this set.

If you have or can borrow a stable VHF signal generator and VHF frequency counter, tune-up is simple. With just a little back-and-forth tweaking of the capacitors and inductors (**Photo E**), I achieved full sensitivity and good selectivity. The audio S-meter is so sensitive that signals of 0.15 microvolt cause the growl pitch to increase. The front-to-back ratio of the antenna represents several octaves of pitch change.

Off to the hunt!

Using the RGE set to get bearings is simple and intuitive. Set the RF gain to maximum and tune in the fox signal while listening on the phones. Switch to the "whoopee" mode, reduce the RF gain control for a low audio tone and readjust the tuning control for highest pitch to center the signal. Now take bearings by turning the antenna in azimuth and listening for the highest tone, adjusting the RF gain control as necessary if the tone gets too high or too low.

Be sure to check with the antenna in both horizontal and vertical orientations and use whichever polarization provides the greatest signal (highest tone). Then walk toward the signal source (the direction of highest tone), reducing

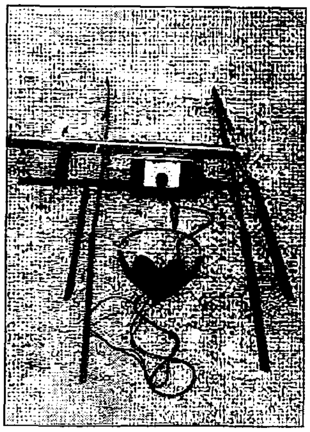


Photo C. *The Ron Graham Electronics two-meter receiver/antenna set is designed for championship competitors. The optional wooden handle may be useful to some, but I have since removed it and just hold it by the end of its short boom.*

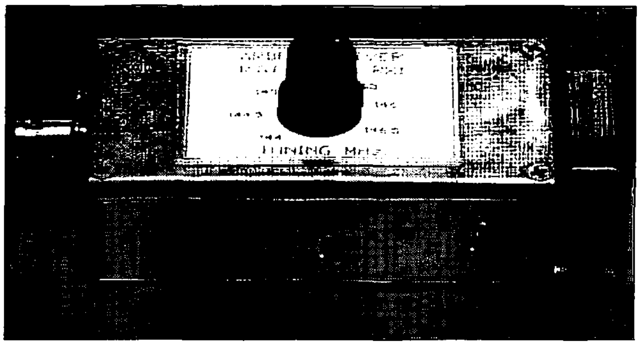


Photo D. *The RX-1 is about the size of a cigarette pack and weighs twelve ounces. It includes a full-range attenuator and audible strength indicator (VCO mode).*

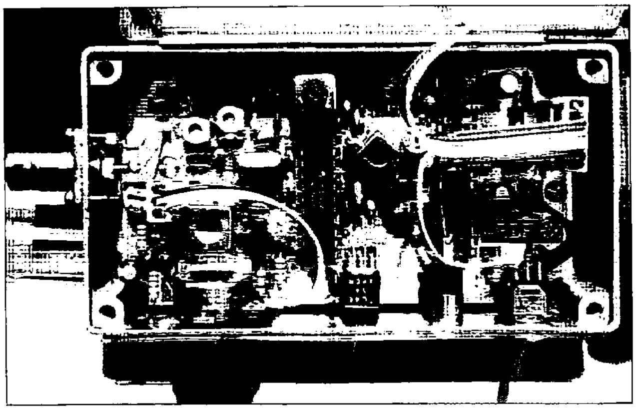


Photo E. Interior view of the RX-1 receiver. The MC3362 IC is voltage-tuned. A linear potentiometer on the cover is the frequency control.

the RF gain control when the pitch gets too high as you approach the fox. After a bit of experience, you'll be able to roughly judge distance to the fox based on the setting of the RF gain control.

With supplied components, the RX-1 covers only about 60% of the two-meter band. The dial marks are 144.0 to 146.5, but you can change the range by retuning the inductor in the first local oscillator stage of the MC3362. It is possible to change fixed resistor values in the tuning circuit to increase coverage to the full 4 MHz, but the single-turn frequency adjust potentiometer is already a bit touchy and this would make it even more so. Some Australian users have replaced this potentiometer with a ten-turn "knob pot" to give more bandspread and make it easier to find the hunt frequency.

Voltage to the local oscillator is well regulated, so tuning remains rock-solid as battery voltage falls from 9 V to 6.5 V. At 32 milliamperes typical current drain, battery life should be about 14 hours. Sensitivity falls off slightly as battery voltage droops to 7.5 V, then it diminishes more rapidly. It's down 15 dB at 7 V and 30 dB near end of life at 6.5 V. The battery mounts externally in its own cradle, where it's very easy to replace, even in the middle of a foxhunt.

Resting (no signal) pitch of the audio S-meter also drops lower as the battery drains. You can use this characteristic as a good indicator of battery status. Q of the tuned circuits in the preamp stage is such that sensitivity falls off about 6 dB at the band edges when peaked at band center. This is not a problem under most foxhunt conditions.

In many countries, two-meter fox transmitters use amplitude modulation. For this reason and to simplify the audio S-meter function, the RX-1 has an AM detector stage. You can tune slightly off frequency to "slope detect" FM signals. This is good enough to identify a hidden transmitter signal from others on the band, but you won't want to use this set to monitor your local repeater.

European/Asian foxhunters use headphones so that their "whoopee" indications aren't heard by other competitors. The RX-1 is intended for headphone listening, too. They aren't supplied, but inexpensive Walkman™ types work fine. The LM386 output has enough power to drive a small speaker, but there's no room for it in the box, waterproofing would be a problem, and battery life would suffer. So stick with the phones.

Besides radio-orienteering, a one-piece RDF set like the RX-1 is ideal for "sniffing out the bunny" at the end of your club's mobile hidden transmitter hunts. I have used it on several recent southern California T-hunts with good results. In one case, the hidden antenna was mounted to be polarized at 45 degrees, between horizontal and vertical. This was immediately evident as I began the on-foot portion of the hunt, and I got nearly perfect bearings by canting the RGE antenna to match the 45 degree polarization.

Once constructed and tuned up by a competent builder, the RGE receiver/antenna combination is a sensitive, effective and easy-to-use RDF tool for two meters. Total cost of the receiver kit, antenna and shipping is about 150 US dollars. For more information, write to Ron Graham, Box 323, Sarina, 4737, Queensland, Australia. Ron has a Web site; you can get there by link from the "Homing In" site.

Dale Hunt WB6BYU took his RX-1 to Japan in September for an international foxhunt sponsored by the Friendship Amateur Radio Society. Read about Dale's experiences and about plans for a multi-nation foxhunt on US soil in next month's "Homing In."

Number 56 on your Feedback card

ON THE GO

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
1153 Malabar Road NE
Palm Bay FL 32907

Little or no warning

At times, it seems that science is getting better at predicting the type of situations where we might be called upon to serve. The ability to predict hurricanes has seemed to improve over the last few years, but then scientists discover the El Niño, La Niña phenomenon, and new questions are suddenly raised. Earthquake predictions, on the other hand, have generally been less than optimal. Nevertheless, we can be lulled into a false sense of security that we will get adequate warning of an impending disaster.

How does this affect us in our efforts to provide emergency communications? While amateur radio is primarily a hobby, it is one of those that can place significant demands on us. Let's compare this with other hobbies. A running enthusiast who wishes to run in a marathon (or even a 10 kilometer race) practices, trains, and prepares for the race for weeks or months before the day the race is to be run. He or she may prepare a training schedule which not only addresses physical training requirements but also a dietary plan, and culminates on the day of the big race. The idea of a race being called with only a few hours' notice would be absurd. On the other hand, much of the time we are called upon to assist in emergency communications, it is with little or no warning.

Disaster or emergency communications support can be as physically, emotionally, and psychologically demanding as an athletic contest. It is not unusual to be called upon to work long hours for several days providing communications under austere conditions. How can we train for our potential communications marathon? Here are a few suggestions:

1. Try to use those skills you would need to use in an emergency.
2. Try to simulate some of the actual conditions you would encounter.
3. Try to promote the art and science of amateur radio.

Many of us are fairly comfortable chatting on the local repeater, or rag-chewing on the low bands. Hams describe their equipment, where they are, what they're doing. Conversations are

casual and spontaneous. This makes for interesting conversation and is appropriate most of the time. However, during emergency communications we need to modify operating procedure to be concise and accurate. A great way to practice this is during network operation. When the ARES, RACES, or repeater net is running, try to practice this style of communication. Perhaps net control would divide the net into two segments, the first requiring emergency-style communications, the latter being more social. The informal portion might be the time to include announcements or the swap and shop segment.

Use public service events for practice. When providing communications for a road race or a parade, agree to use the emergency style during the actual event. Before the event actually begins, and after it ends, drop back to a more casual style.

Another skill that may need to be worked on is to actually copy, in writing, the activity heard on the air. During a local net, preferably one where you do not recognize everyone's name and callsign as soon as they start speaking, try logging callsigns, names, locations, and the time they checked in. When you feel comfortable with that, offer to fill in as net control on occasion. As hard as it is to believe, most net control operators sometimes work late, have equipment problems, and even take the occasional vacation.

What about the conditions you might face in a real disaster? Don't count on the local repeaters being operational. How effective will the net be without the repeater? Neil Sedotal KC5BLQ, the Emergency Coordinator for the Baton Rouge area, periodically calls the emergency net on the usual repeater, then instructs all stations to go to battery power on a simplex frequency. This can be a real eye-opener as to how well a particular area would be covered under disaster conditions. While we get a taste of this during Field Day, it is one thing to operate a bank of stations from one location powered by a generator, and quite another to operate on VHF from a number of locations.

Even operating using a battery-operated handie-talkie may not be realistic if you're loading it into a beam at 125 feet. It is better to use the type of antenna you would be using if working from a high school gymnasium being used as a shelter.

Finally, don't forget that amateur radio is fulfilling a commitment to the community. When operating at a road race or a parade, try to get the sponsors to include recognition of the fact that communications is being provided by amateur radio. Many times the average citizen is unaware of the fact that hams are providing support. Friendly rivalry among local clubs may cause us to emphasize that a particular group is responsible, which may be meaningless to those outside the hobby. When successful companies advertise, they aim the message at the customer, not their competitors. This is an excellent time to show others what an important asset we are. Have a banner made up that says in large letters, "Communications Support by Your Amateur Radio Neighbors." The club name can still be included, but shouldn't detract from the main message.

If we could plan effectively for bad weather, flooding, earthquakes, or other emergencies, they would not be disasters. They are disasters because they give little or no warning. As the Boy Scouts say, "Be Prepared!"

Temporarily off line

On a personal note, I've been cut off a bit from comments for the last month or so because I have been in the process of moving from Louisiana to Florida. This has restricted my ability to get mail, and the phone system where I've been living temporarily is not friendly to the modem on my computer. By the time you read this, I'll be settled in my new home (and hopefully getting my antenna farm transplanted). If you've tried to contact me without success, I apologize. I look forward to your letters, packet messages, radiograms, and E-mail messages. This is your column as much as it is mine. Please continue to share your ideas, experiences, and suggestions. Like any other ham, I do best with two-way communications.

Number 58 on your Feedback card

THE DIGITAL PORT

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703
[jheller@sierra.net]

Keep that mail coming

You readers give me some truly great ideas through your correspondence. It comes in all flavors, E-mail and snail variety, and there are suggestions and solutions as well as questions. One of the most popular subjects has concerned my occasional omission of key facts such as Internet addresses. For several months, you folks were asking about the address at which to find XPWare (line 1 in **Table 1**). By now that has probably fallen off the wish list of most readers, but I hope this chart will be of at least some help by providing that and some other addresses of possible interest.

Dan KA3ZOF sent some ideas about solving serial port problems with diagnostic software. He gave me names of software packages. I ran a few searches on the Internet and found them located on a Web site loaded with useful files. The page address is listed on line 2 in the chart. I found three files referred to in Dan's message and downloaded them.

The largest file, MODEMD 60.ZIP, required unzipping with a copy of PKUNZIP from PKWare. I found it to be a very well-written, powerful utility that displays the ports and their addresses and IRQs, and has extensive documentation. More than just a listing of what the system is doing, it contains helpful suggestions about configuration, too.

The other two files were also compressed files. The difference was that they were compressed with a different system evidenced by the ARJ extender. There were many files listed with this compression scheme for which I did not have the decompression program.

Following a bit of logic, I hunted around the site and found a reference to a Main Index page. And there I found the real meat of the site. There are listings of numerous useful utilities to meet the needs of computer users of all types. And, yes, I did find the file, ARJ250.EXE, to compress/decompress using the ARJ archive system. It works in a straightforward way—that is, if you consider the use of PKWare as the norm. The commands are similar anyway.

Don't try this at home

So that was a good adventure. However, one of the files I downloaded got me in a little trouble. The file MDMLITE. ARJ is a little utility to place a set of pseudo LCD lights on the screen to show when your modem is connected or transferring data. Sounds like fun. I made a quick attempt to watch it work with the copy of BayCom in this desktop computer.

In the process, I hooked up the serial cable to the BP-2M, turned on the W2A, and made a connection to the local PBBS. According to the authors of BayCom software, this won't work while I'm in a DOS window with Windows™ running, so I had never tried it. But it looked OK and here I was, happy as a clam, as I left to eat dinner while the automatic tape backup ran at that time of evening.

On my return the backup was concluded, but there was something not quite right. The cursor would not respond to the mouse. After going through a lot of extra calisthenics to close open files and shut down the computer, I was sure all would be well. "Well" is defined many ways, I guess. The mouse functioned after a reboot, but the tab key was executing a peculiar code. After another cold boot the system settled down. I learn very slowly.

By, now, most of you realize that the BayPac™ BP-2M has occupied more of my time than I would like to admit. As of this writing, I have not gotten the multimode operation (e.g., AMTOR, RTTY, etc.) to function. The HamComm software package comes with some great diagnostics, and I think I have isolated the problem, but I am awaiting an E-mail reply from the author, W. F. Schroeder DL5YEC. (E-mail is quick, but the ham at the other end must translate my message, determine what I really asked, and then reply in English.)

Along the way, Don KA6LWC sent a note concerning the connection pinout I had published a few months back for the 9-pin-to-25-pin serial adapter cable. This one set me to thinking that perhaps the BP-2M multimode problem was a connector fault. He explained that the case of the 9-pin end should connect to the #1 pin on the 25-pin connector. I checked and, sure enough, it wasn't wired that way. Pin #1 is meant to be used for a chassis ground.

I was ready to rewire, but first I slipped the housing off the BP-2M and discovered there was no internal connection for that pin. Saved some time. The reason for the look-see was prompted by a more detailed sheet I located on serial cable and adapter combinations.

Quality ham freeware for Windows 95®

Speaking of the Internet and available software for hams, I found a reference in a TAPR newsgroup to a site with freeware that works with the BP-2M under Windows 95 to do packet. The site is listed on line 3 in the chart. I hope you will be as impressed as I was. I admit I was skeptical at first, because whatever is free usually has a catch to it.

But George is serious about his programming. It isn't a difficult installation, but there is a slight communications barrier. However, if you apply a little patience and persevere to sort out the directions, it pays off (they are in English, but Greek-to-English is difficult at best). The program is excellent, although George does make modest statements about the need for further development.

Along with the modesty, there is a certain frankness about those who would install his software. George flatly states that if you do not know how to make your own shortcuts, his programs are not for you. I have to admit that sounds a little narrow, but just to show him, I never made the start-up shortcuts and the program still plays great. I have so far just brought the program to life from the "Run" window.

Line #	Source	Product	Address
1	XPWare	Multimode TNC Software	www.goodnet.com/~gjohnson/
2	Internet Web page	Utility software collection	www.dc.ee/Files/comm/
3	SV2AGW	Win 95 ham freeware	www.forthnet.gr/sv2agw
4	TAPR	Digital hardware and software	www.tapr.org
5	HamComm	Multimode modem software	www.accessone.com/~tmayhan/schem.htm

Table 1. Chart of addresses. These are the Internet addresses referred to in the article. Line 2 refers to a Web page for which I could not find a precise name listed on the home page, but the content is good.

If you go after this software, there are three files you must download. You will need the AGW Packet Engine, the heart of the system. However, this program will not function unless you download the system file, unzip it and install BWC32. DLL in your Windows/system directory.

The Packet Engine requires configuring, which is accomplished by right-clicking its button on the task bar and selecting properties. Remember, this is Windows 95 lingo. I don't think this program is available for Windows 3.1. You find the instructions on the Web page—no README files—so you may have to go back to check the info a few times.

Once you have these two in place, the AGW Terminal program, the third file you must download, can be unzipped and is ready to be executed. The configuration is very simplistic. You have already accomplished it in the Packet Engine. As a matter of fact, I looked for a specific configuration file and found no such name. You are ready to go except for clicking the File menu, choosing properties, and entering your call.

Putting the SV2AWG freeware to work

The screen shot (see **Fig. 1**), is noteworthy. The pull-down menus are simple. The Help file is empty. George claims the program is so intuitive, you just don't need instructions. That is practically true. I pulled down the Actions menu and found the connect command and was on my way.

The first connect was displayed on the screen in a barely readable font size. I then realized the default point size was 6. Increasing to 12 relieved the eye strain. The fonts displayed on the screen can be chosen from a long list. You will notice two fonts in the picture. I changed fonts in the middle of a message download—just to see.

I hunted around on the node I was using in Reno, found a small functional ham BBS, W7UNR, at the local university, and connected to it to watch the system work. George claims you can have a hundred ports open at once. I like to keep life simpler than that, but that is an impressive number.

This program is not specifically written for the BayCom-style modem. The original version is meant for use with a regular terminal node controller (TNC). The BayCom capability was just recently written into the original program. George also has available on his Web site a logging program, a BBS program, and a DX Cluster program. I say they are worth looking into.

Kits for TNC?

Some have asked if there are any kits to build a terminal node controller (TNC). The only kits I am aware of at this time are from the Tucson Amateur Packet Repeater group (TAPR) (see line 4 in chart) and another from the BayCom people in Europe. Neither of these is a TNC, but a modem that is software driven. There is one hinted about in some messages from the UK which I think is similar again.

TAPR at one time marketed a kit to assemble your own TNC, but that has been discontinued. They operate as a nonprofit organization, and the requests for support overwhelmed them. It became one more of those modern technology developments that is more practical to purchase than to build.

The modems, however, are popular and the plans are readily available. On the Internet (see line 5 in the chart) you can find HamComm's recommended schematic complete with parts list.

I purchased mine assembled, in the interest of time. The real challenge is software—there are many packages available. Last month, I listed the software I had found—and there is still more to come.

Nearly all software being developed is shareware, so you can try it for fit before you buy. Shareware is often not well polished and the support is limited, but if it is out there, it has worked for someone. If you spend a little time and experiment you will usually find what you are looking for. Plus, if it is almost right, you can contact the author and he may just add what you want and keep it in there for future releases.

If you have questions or comments about this column, please E-mail me at the address above and/or CompuServe [72130,1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line at [KB7NO@N7NPB.# NONEV.NV.USA.NOAM]. For now, 73, Jack KB7NO.

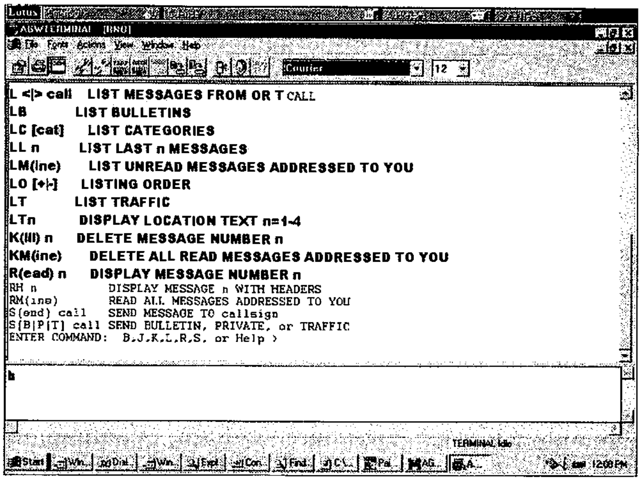


Fig. 1. SV2AGW freeware Win95 terminal program in action. Note different fonts.

Number 60 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

*Mir*ly operating

Ever since an American astronaut took up residence on the Russian space station, *Mir* has been in the news. Astronaut Norm Thagard went to *Mir* in March of 1995, and there has been an American on board ever since. Less than six months ago *Mir* was a party to a collision in space with a resupply ship. Since then there have been guidance computer problems, power shortages and life-support system difficulties. Questions were raised about sending any more astronauts to the station. At the last minute before the launch of *Atlantis* in September, NASA decided to continue the program and sent Dave Wolf (KC5VPF) to *Mir* to replace Mike Foale (KB5UAC).

There were problems with *Mir* prior to American participation, but the difficulties were not as prominent in the news in the US. On the positive side, all the experience gained with *Mir* will aid in planning and operation of any future multi-national space station.

While the radio, TV and newspapers reported difficulties and hardships on *Mir*, amateur radio voice and packet activity from the space station seemed unaffected. Primary operating frequencies have been changed and experiments on 70 cm FM have been conducted without interruption. As long as there are astronauts or cosmonauts on *Mir*, there will be some form of ham activity.

Listening for *Mir*

Two-meter voice and packet operation are the dominant ham activities on *Mir*. The primary frequency is 145.985 MHz. Other frequencies have been used in the past (145.55 simplex and 145.200-up/145.800-down), but the new simplex frequency near the top of the amateur satellite band seems to be working well.

The easiest way to listen for *Mir* is to set a two-meter radio or scanner on 145.985 MHz FM. Variables like Doppler shift, antenna orientation, distance and other factors will make a solid copy difficult on a simple system with a whip antenna, but most passes will be detected in time to switch antennas or orient the receiver and do some fine tuning for best reception.

The best option is to track the space station with beam antennas while continuously correcting for frequency shift, but good results can be had simply by leaving a squelched receiver with an omnidirectional antenna on all the time. It is even possible to make contacts with *Mir* using a simple system and calling for *Mir* when reception is best. The voice callsign for *Mir* is RØMIR, although Dave Wolf may use his own call. The packet callsign for the onboard Personal Messaging System (PMS) is RØMIR-1. The packet system is on all the time. Voice contacts are only possible when a crew member is available, and the crew is only up when Moscow is awake. Thus voice contacts usually occur in the early morning or evening (Moscow time).

Improved procedures

For serious *Mir* operation it is best to use a tracking program and current *Mir* Kepplerian element sets. AMSAT (The Radio Amateur Satellite Corporation) sells tracking software for PCs and other computers. There are also programs available for free or as shareware that can be just as effective for *Mir*. A good place to start for software and orbital element sets is the AMSAT site on the Internet. The Universal Resource Locator (URL) is [http://www.amsat.org/]. Even if your antenna is only a simple outside ground plane, knowing when to listen and how much Doppler shift to expect is very helpful. Other Internet sites to check for *Mir* information include: [http://www.grove.net/~hearsat/], [http://shuttle-mir.nasa.gov/] and [http://www.maximov.com/mir/mir2.html].

On two meters the Doppler shift is usually no more than 3.5 kHz on an overhead pass. At the beginning of the pass the signal will come in high. When the space station is at its closest approach there will be no apparent shift, and when *Mir* is moving away from your location the signal will be low in frequency. For most radios that tune in five-kilohertz increments, three receive/transmit memorized frequency pairs can be programmed. Memory one should have a receive frequency of 145.990 MHz and a transmit

>>> 00:05 Connected to RØMIR-1
Logged on to RØMIR's Personal Message System
CMD (B/H/J/K/KM/L/M/R/S/SR/V/?)>

Msg #	Stat	Date	Time	To	From	@BBS	Subject
239	P	09/23/97	07:56	RØMIR	W5ACM		Hello from Houston!
238	P	09/22/97	18:31	NASA5	N6CO		World News 9/22
237	PR	09/22/97	18:30	ALL	N6CO		2 Line *Mir* Keps 9/22
236	P	09/22/97	18:29	NASA5	N6CO		Misc
235	P	09/22/97	13:49	RØMIR	WF1F		Mike
234	P	09/22/97	13:10	RØMIR	VK2JYE		C RØMIR-1
233	P	9/22/97	12:08	ZL1AKJ	RØMIR		QSO
215	PR	9/20/97	10:32	ZL3TDA	RØMIR		Welcome back
214	PR	9/20/97	10:21	VE3VRW	RØMIR		Thanks
213	P	9/20/97	10:20	VE7IMM	RØMIR		Fly safe

8725 Bytes free
Next message Number 240
CMD (B/H/J/K/KM/L/M/R/S/SR/V/?)>
– Logged off
>>> 00:11 Disconnected from RØMIR-1

Table 1. Logging on to the Mir *PMS.*

frequency of 145.980, memory two can be set for 145.985 MHz simplex, and memory three should have the receive set to 145.980 MHz and transmit on 145.990 MHz. Tune the receiver for best reception during the pass. The appropriate transmit frequency will already be set.

Working the PMS

The Personal Messaging System on *Mir* is very similar to other radio bulletin board systems (RBBS). The only difference is that this one covers almost the whole Earth twice a day and is a moving target. It uses standard packet radio at 1200 bps AFSK on FM. The commands are simple. Their letter representations are shown at every command-line prompt from the system. Familiarity with packet operation is essential since tracking, Doppler, timing and competition with other unheard stations are all happening simultaneously. A typical *Mir* pass will only last 10 to 12 minutes, so there's not much time for mistakes. **Table 1** shows some typical text as received from *Mir*. In this example the connection to *Mir* was established by connecting to RØMIR-1 using a small FM transceiver with amplifier and beam and a Tigertronics Bay Pac BP-2M. An old 286 laptop was used to run the Baycom software. After the connection had been established, the "L" command was sent to show the last 10 messages in the system. The "B" command is used to log off. To send a message to the crew it is appropriate to use the "S" command followed by RØMIR. You will be asked for "Subject?" and "Message:" When done, simply send a "/EX" or CONTROL Z to save the exchange. Memory is very limited in the PMS, so it is not a good idea to send long messages. You should also not send messages to stations other than those on *Mir*. The PMS is for the *Mir* crew and not to be used as a store-and-forward system for ground-based users. There are other digital satellites that perform that function. The "H" command provides a list of the command letters and their meanings. You can expect to have a message waiting for you in a day or so in response to any that you post to the *Mir* crew. **Table 2** shows an example of a log-on that announces new mail.

Other packet operations

The packet system on *Mir* is not only a bulletin board in the sky. It is also possible to work RØMIR direct. This would be a connected two-way, keyboard-to-keyboard packet QSO. Before the PMS, this was the standard packet contact. Another use of the system is to use the digipeat function, or just to send transmissions using the UNPROTO mode. Direct connections using *Mir* are not recommended, but UNPROTO operation is accepted since it does not use excessive resources for retries. To set the UNPROTO mode in your Terminal Node Controller (TNC) type the command "U CQ V RØMIR". Switch to the CONVERSE mode and see what happens. It is possible to pass on messages to other stations within the 1000-mile wide footprint of *Mir* as it passes overhead.

Getting a *Mir* QSL

Years ago it was difficult to get a QSL card for a *Mir* voice or packet contact. The card had to go to the Soviet Union for processing. Sometimes the wait was long. Other times the wait never ended. Today it is not a problem. The US QSL manager for *Mir* is Dr. Dave Larsen N6CO. Dave is the system operator (SYSOP) for the *Mir* PMS and he is the head of MIREX operations in the US. MIREX stands for the *Mir* International Amateur Radio Experiment. It was formed to handle prescheduled *Mir* school contacts. Dave's address is P.O. Box 1501, Pine Grove CA 95665. Dave's Internet address is doc@volcano.net, and the packet address is N6CO@N0ARY.#NOCAL.CA.USA.NOAM. When requesting a *Mir* QSL don't forget to include all pertinent information on your QSL card and to provide a self-addressed, stamped envelope (SASE) for the return card.

Special *Mir* Achievement Award

Earlier this year Dave announced a new award for those who had completed both voice and packet contacts with *Mir*. It is a personalized color certificate (8 x 10) with a photo of *Mir* prominently displayed in the center. My certificate is shown as **Photo A**. The certificate shows the callsign RØMIR regardless of the callsign(s) worked. My contacts were for a voice QSO with U2MIR in 1988 and a packet contact with U2MIR in 1991. To get the certificate send Dave a $10 donation along with copies of your *Mir* packet and voice QSL cards. Return postage is covered by the donation. Use Dave's *Mir* QSL address shown above for certificate requests.

Future *Mir* operations

In September, *Mir* moved to 70 cm for a three-week test. In recent years the interference on two meters (even in the satellite band) has been excessive. A new operating frequency was chosen on 437.650 MHz to find out if a

```
>>> 23:09 Connected To RØMIR-1
Logged on to RØMIR's Personal Message System

You have mail waiting.

Msg#  Stat  Date      Time   To      From    @BBS  Subject
246   P     09/23/97  13:38  W5ACM   RØMIR         QSO

CMD (B/H/J/K/KM/L/M/R/S/SR/V/?)>
Posted    : 09/23/97   13:38
To        : W5ACM
From      : RØMIR
@BBS      :
BID       :
Subject   : QSO

>>> 23:15 Disconnected from RØMIR-1
```

Table 2. "Mail waiting" message from the Mir *PMS.*

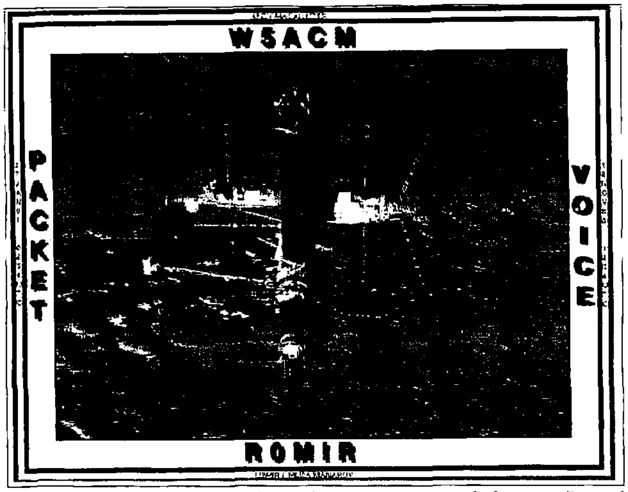


Photo A. The Special Mir *Achievement Award for confirmed packet and voice contacts with* Mir.

higher frequency band would be better. The results were mixed, but it was a beginning in the effort to escape the congestion on two meters.

Over 100 stations around the world made the transition to 70 cm. Voice contacts were logged and a lot of packet activity with the PMS took place. The radio on *Mir* is a dual-band Kenwood. It worked reasonably well during the experiment with the external dual-band whip. For terrestrial stations with beam antennas, signals were good. Doppler was the biggest problem. At 70 cm the shift can be as high as 20 kHz from beginning to end of an overhead pass. For all serious users this required effort for good voice communications and serious work for effective packet connections. While operations on two meters are easier for ground-based stations, there is no interference on 70 cm for the *Mir* crew. Other ground-based two-meter activity and *Mir* VHF operations on 143.625 MHz are problems on *Mir*. More experiments on 70 cm may be scheduled in the future to find some relief.

Straight Key Night

You're invited to join in the 26th annual Straight Key Night on OSCAR (Orbiting Satellite Carrying Amateur Radio), sponsored by AMSAT-NA for satellite enthusiasts worldwide. There are no rigorous rules and no need to send in any logs. Just call "CQ SKN" in the CW passband segment of any OSCAR from 0000 to 2359 UTC on January 1, 1998, or answer a "CQ SKN" call from another station. OSCAR Zero (moonbounce) contacts count also. Of course, all SKN operating must be done with a straight hand key.

Those participating are encouraged to nominate someone they worked for recognition as having the "best fist." To send in a "best fist" nomination, address it via E-mail to [w2rs@amsat.org], via packet radio to [W2RS@WA2SNA] or [W2RS@GB7HSN]. Those nominated will be featured in a bulletin sent to various ham publications and to the AMSAT News Service.

Number 62 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153
[ajr@ari.net]

A LIT-tle chilly

It's December, and getting cold here in the mid-Atlantic states. And, I'm afraid, it's a LIT-tle bit chilly here in the shack—chilly because I made a little mistake, which I hereby correct.

In the October column, I responded to a question from Ted Bear W6RHB regarding the V20 CPU chip in his computer. In that column, I said:

"The old V20 chip, like its cousin the Z80, is poorly supported at this time."

Well, that's just wrong, wrong, wrong! Here's thanks to the E-mail kick I received from fellow columnist Michael Geier KB1UM, of "Ask Kaboom." Michael reminded me that:

"Actually, most DOS software, even including WordPerfect 5.1, will run quite happily on it. I have an old mini-notebook with a V20 or V30 (basically the same thing) in it, and it can run all kinds of things surprisingly fast."

In fact, the V20 was a second-sourced, updated 8088 chip, the same chip that was in the original PC. Michael also points out that:

"The CW software put out by MFJ (and written by Intellisoft) runs fine on it, and it's not a BASIC program. The CW copying capabilities of that program, though, seem pretty weak, no matter what kind of processor you use. I'm sure there are other DOS programs to read CW. In fact, those public domain disks sold at hamfests have plenty of them. They should all run fine on the V20."

The many simple programs in the RTTY Loop Software Collection should run as well. So, I stand corrected. Thanks, Michael.

Gift time

Some time back, I began featuring in the December column items or sources of gifts for the RTTY-active ham. This month, I have rediscovered an old friend.

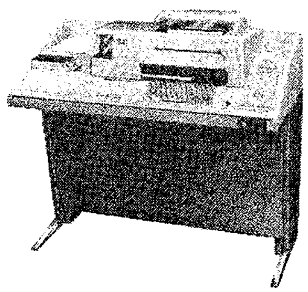
Fred Schmidt N4TT has been running Typetronics in Ft. Lauderdale, Florida, since the mid-1960s. I remember Typetronics when I was getting started about that time in ham radio, and especially when I was entering into the world of digital communication.

Here is your source for all things, and I do mean all things, related to Teletype™ machines. Parts including gears, keytops, covers, type bars, and even cranks are all available. Not satisfied with parts, Fred also stocks manuals for just about every machine, and consumables such as ribbons, paper tape, and paper. All of these, by the way, encompass not only machines of the Teletype Corporation, but Kleinschmidt and Mite teleprinters as well.

And besides all of these goodies, the stock at Typetronics also includes a number of terminal units, tubes, tools, and other accessories. In short, Typetronics is a one-stop shop for all of your teleprinting needs. Contact them at P.O. Box 8873, Ft. Lauderdale FL 33310; telephone (954) 583-1340. Be sure to tell them you read about it in RTTY Loop, okay?!

While we're on the subject of vintage machines, here's a place to see them, up close and personal. The North American Data Communications Museum bills itself as featuring Telephony Technology from Telegraph to Digital Transmission. Located at 3841 Reche Road, Fallbrook CA 92028-3810, it has on display 15

35 ASR Teletype (1968)



35 ASR Teletype (c1967)

100 words per minute, 8 level ASCII coding, 110 Baud, 4 row automatic send and receive, 101C Dataset, Bell System dial TeletypeWriter eXchange (TWX) service. 4 row teletypewriters were deployed with their own switched network, called Wide Area Data Service (WADS) which was separate from the national DDD network.

Photo A. *You'll find this Model 35 ASR image—and many more like it—on the Web site of the North American Data Communications Museum.*

different Teletypes; terminals; a DDS hub and end office; over 110 different test sets from telegraph to DS-1, and more, with Dataphones, Datasets, parts and datacomm accessories; not to mention over 100 volumes of literature and documentation. Take a look at their Web site at [http://www.hem.com/nadcomm]. Pictured is a look at the Model 35 ASR from their Web site's virtual tour of the museum. Check it out if you're in the area, or pop in over the Web.

Along with old machines and old paper, I received a question for a program that will output in Baudot, for use with a teleprinter. I believe the old program RTTY 12G will do this. This program is about ten years old, and the documentation even mentions the IBM PCjr! Written by Glenn E. Welman KF4NB of Lexington KY, this is a small DOS-based program which, for that matter, may well run on that V20 mentioned above! I will add it to the RTTY Loop Software Collection, as well as feature it on the RTTY Loop home page for downloading.

There have been quite a few products promoted for lubricating old teleprinters, since many of the "original" products are no longer available. One such product which has been brought to my attention is "One Lube," available in the automotive department of most large variety stores. This lubricant is not likely to attract rodents and such, and seems to fill most requirements of teleprinter lubrication. I would be interested in hearing from readers with other experiences in the realm of teleprinter lubrication and maintenance.

Lore

As long as we are delving into ancient history, here's a piece of Teletype folklore that has recently surfaced on the Internet. The question was raised as to why teleprinters printed in all upper case. As the story goes:

Decades ago, back in the days when it was the sole supplier of long-distance hardcopy transmittal devices, the Teletype Corporation was faced with a major design choice. To shorten code lengths and cut complexity in the printing mechanism, it had been decided that teletypes would use a monocase font, either ALL UPPER or all lower. The Question Of The Day was, therefore, which one to choose. A study was conducted on readability under various conditions of bad ribbon, worn print hammers, etc. Lowercase won; it is less dense and has more distinctive letter forms, and is thus much easier to read both under ideal conditions and when the letters are mangled or partly obscured. The results were filtered up through management. The chairman of Teletype killed the proposal because it failed one incredibly important criterion:

"It would be impossible to spell the name of the Deity correctly."

In this way (or so, at least, hacker folklore has it) superstition triumphed over utility. Teletypes were the major input devices on most early computers, and terminal manufacturers looking for corners to cut naturally followed suit until well into the 1970s. Thus, that one bad call stuck us with Great Runes for thirty years.

I don't know. It's a nice story, but I really don't buy it. After all, all those 5 x 7 display tubes and early dot-matrix printers used all caps. Let me know what you all think about this apocryphal story.

I mentioned the RTTY Loop Software collection, a growing group of programs of interest to the RTTY amateur. Receive a copy of the listing of programs available, and instructions on how to get the programs themselves, by sending a self-addressed, stamped envelope to the above address, or by requesting one by E-mail from my E-mail address above, or by logging on to the RTTY Loop home page, at [http://www2.ari.net/ajr/rtty]. Be careful of the case of those letters, by the way—they are all lower case. Trying to retrieve the page by typing RTTY instead of rtty will not work, thanks to the case-sensitive Unix system used on this and many other Web servers.

More next month—maybe even something from the present! Then again, who ever said RTTY was at the forefront of this crazy hobby of ours?

Ham Radio Fun

We Joined the North Pole Network!

Radio ho ho!

Michelle "Missy" D. Hollenbeck AAØOF
Andover Schools Amateur Radio Club
Andover Middle School
1628 N. Andover Road
Andover KS 67002

The Andover Schools Amateur Radio Club was looking for a holiday project that promoted amateur radio. Our club had limited funds, students were busy with holiday shopping and homework, and Christmas Day was quickly approaching. Lo and behold, the December 1996 issue of *73 Amateur Radio Today* arrived just in the "Nick" of time. After reading the article written by April Moell WA6OPS and Joe Moell KØOV, our decision was finalized. Andover Schools Amateur Radio Club (ASARC) would join the North Pole Network!

The students and I talked about how amateur radio operators in California had provided opportunities for sick children to talk to Santa Claus. Knowing that transportation for nondriving middle school students was a logistical concern, the students agreed that the best place for a "Talk to Santa" special event station would be at the local Andover IGA™ store.

A week before the scheduled event, I telephoned the manager of the IGA store.

"Glen, this is Missy from Andover Middle School. My amateur radio club would like to set up some amateur radio club equipment at the front of your store so that children can talk to Santa."

Glen was delighted with the idea. He told us that we could have the area directly in front of the ice freezers. He also told us to make signs to promote the event. Additionally, the IGA would place a table and chairs at the front of the store for our use. My basic fear was put to rest—there was an electrical plug nearby.

Everyone wanted to talk to Santa, and more importantly, to Mrs. Santa, too!

My students were impressed with the Moells' idea of handing out commemorative buttons. But with limited funds and no button-maker, we were in a quandary about what to do. Luckily for us, the mom of one of my former students (Sarah Galloway KBØMDP) worked at the Wichita USD 259 Educational Support Center. The Center had a button-maker and charged only 20 cents for each completed button.

With the special event station quickly approaching, our club made a visit to the Educational Support Center. Sure enough, the Center had all the needed supplies and several button-makers. But it was important to the students that our buttons had a good message, looked nice, and promoted amateur radio.

We decided on the slogan. "Using Amateur Radio, (child's name) talked to Santa." The child's name portion was intentionally left blank so that the children could choose their own special buttons and handwrite their own names.

After completing a sheet of six button designs, copies on festive red and green paper were made. Although we thought that the cutting-out process would be tedious, the Center had a special circular cutting tool that quickly and accurately cut out the designs. Even though the buttons looked nice, something definitely was missing. Thankfully, the Center had adorable tiny Christmas stickers.

The addition of assorted sticker designs truly made the buttons one of a kind.

The button assembly went quickly—that is, after we learned how to assemble the buttons correctly. First came the back part of the button, then the top part, and finally, the colored paper design and plastic overlay on top. With two quick pumps of the button-maker's handle, the buttons were complete. After we got the assembly part down pat, over 70 buttons were completed in less than an hour.

Then came the creative part! The club members were not satisfied with just handing out "I Talked to Santa" buttons. They also wanted personalized buttons that had other Christmas-related amateur radio themes. Laughter and giggles followed after numerous button designs were implemented. Some new button messages included "Santa Helper," "Rudolph uses GPS," "Santa uses GPS," and "Santa Only Talks on Amateur Radio."

Heeding the advice of the Moells, club members were concerned about handing out candy canes. (In fact, one of our members is diabetic. He shared with the club how hard it was to be a kid who can't eat candy.) Fortunately, we found some sugar-free candy canes along with regular ones.

When the special event was only two days away, a problem emerged. Our Amateur Radio Santa would not be able to help us with our special event station. I called for other amateur radio operators to help, but many were hesitant. After all, Christmas was only a few days away and everyone had so much to do.

Also, I was concerned about which frequency to use. Should I use simplex and not tie up the local repeater? Or should I use the local repeater so many people could hear the special event communications? My Elmer, Ray Metcalf WØQNX, said, "Use the repeater! That's what it's for!" So without any further hesitation, the use of the El Dorado Repeater (WØRGB) was planned.

But what about Santa? At the last moment I called upon Carol Musick KBØONM, a second-grade teacher in our district, to help us out. Carol said that she'd be glad to be our Mrs. Santa.

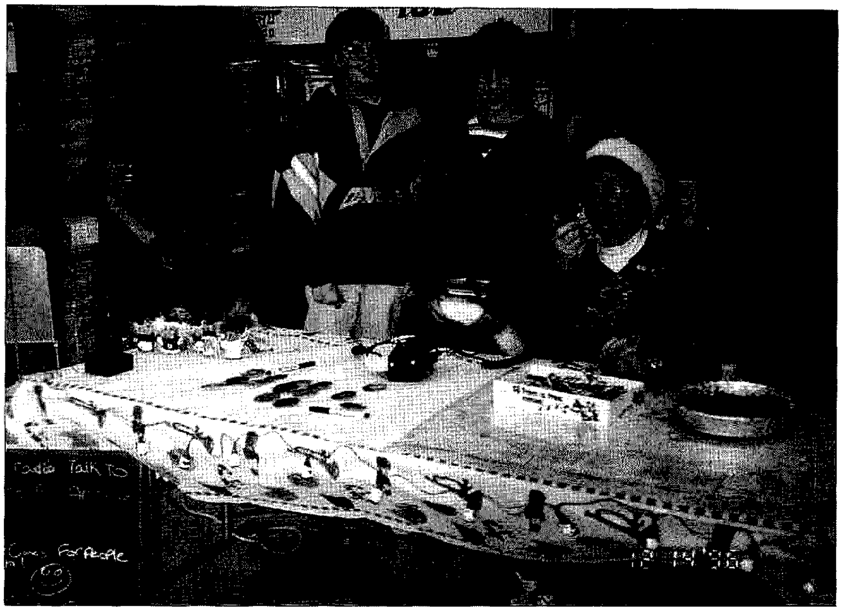


Photo A. Special event station at the Andover IGA. Carol Musick KBØONM is making a radio check before the event starts. Notice the charcoal briquettes in the background!

Then the students came up with a wonderful idea. How about if they were Mrs. Santa's elves?

Surely not, I thought. My middle school students pretending to be elves? What about being cool and all those adolescent rituals that they go through?

When it came time to set up the special event station, the students met my red Jeep Cherokee and me in the IGA parking lot. (Knowing that Mrs. Santa would be sitting in the Jeep with a two-meter handheld, it was important to park in an inconspicuous part of the parking lot.) Quickly we unloaded a two-meter radio, magmount antenna, power supply, world map, Christmas lights and tablecloth, candy canes, and of course, the buttons.

As we approached the IGA store, we were met with a huge display of charcoal briquettes occupying our planned location. The students exclaimed, "Why in the world are they trying to sell barbecue stuff during December?" After some quick footwork by the management, a table was brought to us and squeezed in between the massive stacks of briquettes. Unfortunately, the briquettes also covered up the electrical outlet. Next, the management provided a tattered extension cord to supply us electrical power. (We quickly had a safety lesson about tattered extension cords.)

Time was of the essence. In just 10 short minutes, our special event station was scheduled to go on the air. "Mrs. Santa" arrived, garbed in a festive outfit. "Carol," I gently reminded her, "the kids won't see you." But Carol didn't seem to mind. She grabbed three of the student elves and off to the Jeep they ran. I turned around to look at the remaining students and they were decked out in Santa hats and Rudolph ears (and I thought middle school students always were concerned about being cool).

Quickly the students and I hooked up all the radio equipment. Alas, there was no apparent ground plane for the magmount antenna. But as my students gazed at the massive stacks of out-of-season charcoal briquettes, we realized that they were kept in a metal frame. After a quick inspection, we determined that the top of the stack had a metal plate. Splat! went the magmount antenna, as it stuck to the mountain of briquettes.

"This is a special event station ... calling CQ CQ CQ ... looking for Mrs. Santa ... this is AAØOF from Andover, Kansas ... "

Photo B. ASARC in their school ham shack. Seated (in middle with mike) is new Tech Plus Joseph Haynes KBØZCA. The students were busy being student elves with the second graders in Carol Musick KBØONM's class. Photo by AAØOF.

"This is Mrs. Santa, KBØONM ... I hear you loud and clear ... "

The conversations that followed were truly a wonderful display of positive amateur radio public relations. At first we thought that only children would want to talk to Santa, but we were wrong. Everyone wanted to talk to Santa, and more importantly, to *Mrs.* Santa, too!

Carol KBØONM was a remarkable Mrs. Santa. Some of the conversations went like this:

"Yes, this is Mrs. Santa. Oh, just wait a moment, I must wash my hands. I've been busy baking cookies. Oh, there we go ... now what was your wish for Christmas?

"Oh, Santa and I always use amateur radio for our communications. We are so proud to be amateur radio operators.

"Yes, the elves are busy building toys for all the children. Would you like to talk to Elf Mickaela? She's our expert truck builder."

Then, out of the blue, came a deep "Ho! Ho! Ho!" Excitement filled the air. But who was Santa? Did one of the local amateur radio operators decide to join in on the fun?

After several conversations with Santa, we finally realized that the deep voice was also Carol's. At this point, multi-talented Carol had become both Mrs. Santa and Santa himself! Likewise, the elves had become reindeer caretakers, Nintendo™ 64 builders, and Tickle Me Elmo™ creators. There was even an elf who specialized in making money!

It's amazing how quickly time passes when you're having fun. Fun in this case was watching the faces of children, parents, and store clerks talk to Mrs. Santa, Santa, and the hard-working elves. The buttons, quite a novelty item, were a wonderful way to celebrate the special event station.

To thank Carol KBØONM for all her hard work, the following week the student elves and I set up a mini-special event station at our school ham shack. Carol's second grade students were then able to talk with "Santa's elves" via amateur radio.

ASARC is already discussing plans for next year's "Talk to Santa" special event station. We already know that we'll need more buttons and candy canes. Who knows? Maybe we'll request those massive stacks of barbecue briquettes!

Let Your Fingers Do the Talking

... or, wire you smiling?

Arthur R. Lee WF6P
106 Western Court
Santa Cruz CA 95060

When you suddenly find that your microphone won't work or your key isn't functioning, it's time to take matters into your own hands.

You have often heard that in an emergency, we amateur radio operators can send code by flashlight, or by radio by touching two wires together. Of course we can do it—it's simple. But how many of us have tried? With today's modern high-quality electronics, we often ask ourselves how such an emergency could ever present itself. After all, our rigs are nearly foolproof and who ever heard of our microphones failing? We know it is far easier, and quicker, to go "voice" whenever the need arises for emergency communications.

As an instructor of Novice classes, I often tell my students to make up their own telegraph keys out of hacksaw blades, bent metal forks, or any imaginable contact material. One of my more innovative and enthusiastic students constructed hers out of her father's discarded flexible metal measuring tape. It worked fine!

As always, true emergencies never happen when we are prepared. They pop up at the most inopportune times and at all hours of the night or day. Emergencies happen all the time, some big, some small. Here's one that happened to me.

My daughter-in-law Cybele KC6LKT, a Technician-class, was home in Sacramento with her rig when our schedule for CW practice on 40 meters came up. I had just arrived on vacation in San Diego and rushed to set up the rig my daughter had stored in the spare bedroom. Anticipating that the battery would be dead in the electronic keyer after a year's storage, I had purchased a nine-volt replacement battery. I also considered that the included battery might have just enough life in it for one last QSO before replacement.

Happy with the thoughts of talking to Cybele, I hooked up the rig and gave it a test. Everything was perfect. Even the keyer and paddle performed flawlessly, although the keyer audio sounded a bit weak when I sent a string of off-the-air CQs and callsigns.

On schedule, Cybele began carefully tapping out, "WF6P, WF6P, de KC6LKT." Fine, and she was right on frequency.

I came back with my callsign and we were in business.

She came back with a cheery, "Gud morn Dad, how u tdy?" I made my reply and the keyer started wildly misbehaving in the strange manner that they do when the batteries go flat. There was just enough juice for me to send an $\overline{\text{AS}}$ (wait) or two, then my callsign. Cybele came back with her "OK, OK," and kept the frequency open.

I popped the cover off the automatic keyer, hoping to snap in the nine-volt battery and resume our QSO. I mentally congratulated myself for my foresight while contemplating what nice things I might say in our QSO. I was dumbfounded when my eyes focused on the two AA batteries that formed the power supply. Help! A frantic search was made throughout the house for some spare AAs. No luck.

Cybele began calling me again, wondering where I had ventured off to. Not to worry, I thought: My trusty old straight key lay nearby. I attempted to push the standard jack into the miniature jack receptacle on the back of the rig. What the heck? Quickly unscrewing the jack cover, I found the connections soldered to the terminals.

Cybele kept calling.

By now I was feeling helpless and frustrated. The ham keyer lead from the rig terminated in an RCA plug for

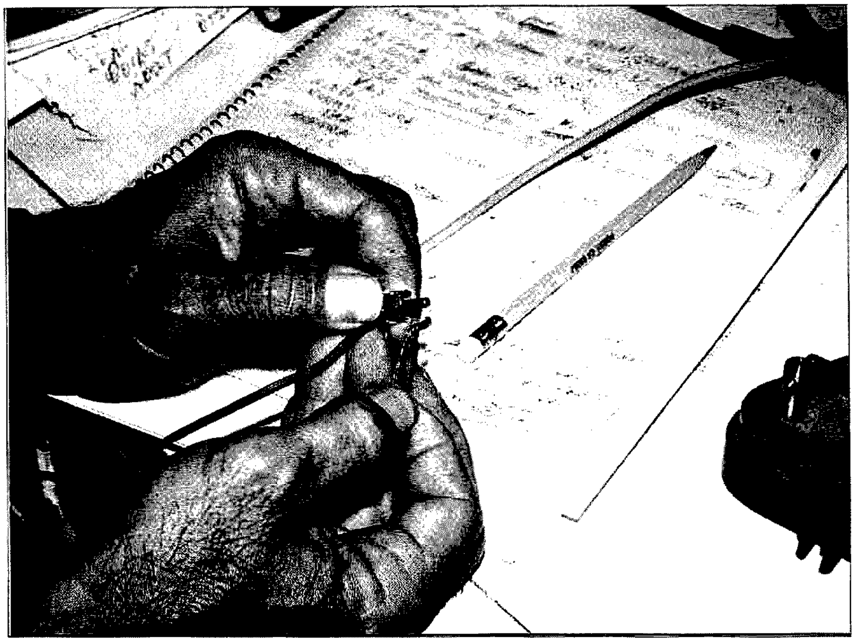


Photo A. When batteries failed, a quick solution to the problem was necessary in order to continue with the QSO. One end of a jumper was wrapped to the ground side of the RCA jack and the other end used to touch the center connector. Morse code can be successfully sent at speeds up to 10 wpm by completing the wire contact. This "hasty key" can be made in only a few seconds if nothing else is available.

the keyer. Aha! A solution presented itself. Taking a spare length of hookup wire, I wrapped one end around the ground side of the RCA plug. Then, with the lead plugged into the miniature jack at the back of the rig, I touched the wire to the center connector of the RCA plug. As could be expected, I heard a nice "dit!" on frequency.

Without pausing, I answered Cybele, simply offering a short comment to the effect that I was using a "wire touching" method to send code, and that the paddle and keyer were not being used.

How well did it work? Well for the next 55 minutes we carried on with our CW QSO at about her speed of eight words per minute. There were no problems with my sending or hers. It sounded fine, except that my fingers did get a bit tired from holding the wire tightly to the ground side of the RCA plug.

Cybele did pay me a somewhat dubious comment later, when we got together in person. "Dad, your sending was fine, it was just like normal!" Hmm ... I wasn't sure about how to take that but I know she means well.

How's she doing on her code progress? Well, she's passed the General written exam and can copy about 10 wpm. Some things take practice and patience. 73

Amateur Radio Maritime Mobile Nets

Staying in touch—and staying safe—on the briny.

Arthur R. Lee WF6P
106 Western Court
Santa Cruz CA 95060

When blue water passes under your keel and the compass points to new horizons, the amateur maritime mobile nets provide a friendly and reliable network of faithful and skilled radio operators who are standing by to help out in time of routine or emergency needs.

Without a doubt, one of the most important and interesting things you can do when offshore cruising is to link up with fellow sailors and land-based radio operators on the ham maritime mobile nets. This vital link can provide countless hours of entertainment, specialized marine weather observations, useful cruising information, and perhaps most important of all, a lifeline in case of emergency. In addition, it can provide a valuable and unique morale-building service: telephone patches to loved ones ashore.

Where do you start?

If you are serious about cruising, give some thought and priority to outfitting your boat with ham equipment. To operate ham radios you will need a ham license, preferably a General class one. The General class license is relatively easy to obtain, although some study of FCC regulations and low-level technical material is required. Also, you will have to learn (or relearn) to use Morse code. The General class amateur radio license is designed for use by the average person and the written test material is relatively easy to master without any prior knowledge of electronics. The code can be learned after a few weeks of effort but to get code speed up to the required 13 words per minute usually takes about a month or two longer. Test information, plus code practice tapes and study guides, complete with questions and answers, are available from the American Radio Relay League (ARRL), 225 Main Street, Newington CT 06111. Begin with *Now You're Talking*, for the Novice and Technician class licenses. The cost is approximately $20.00. Study guides for the General class license sell for about $10. Most Radio Shack™ stores carry these materials. And don't forget the famous series of code-training tapes offered by *73*'s Radio Bookshop.

What are the maritime mobile nets?

Loosely defined, the nets are a conglomeration of ham radio operators who have a strong personal interest in radio, boating and sailors who go down to the sea in ships. Almost all are sailors themselves or have been sailors in the past; many are ex-military, naval, or commercial operators who know what it is like to be out on the big ocean and who place a high value on radio communications. In general, those hams who inhabit the nets are highly skilled, responsible operators who spend many hours per day helping one another and other boaters with communications.

What purpose do the nets serve?

All of the maritime mobile nets are there to serve boaters and provide a regular agreed-upon calling frequency where operators can join with each other to pass emergency or routine personal *non-business* message traffic.

Where do we find the nets?

There are approximately 100 nets with some names indicative of the areas they serve. Some nets have extensive ranges, others are very local in nature. A sampling of net names are: Great Lakes Emergency Net, Pitcairn Net, UK Maritime Net, Florida Coast

Some Terms Used on the Ham Radio Nets

Net Control	The person in charge of running the net for the day.
Relay Station	Someone who helps relay messages to net control from stations not heard by net control.
Checking In	To contact net control, usually give the suffix of a callsign only, until recognized by net control.
"Recheck"	A term to signify that you were unable to find the station you were looking for and now wish to return to the net.
"Re-entry"	A term used to signify that a previously checked-in station has gone off frequency, completed its traffic, and is returning to the net.
"Contact"	You have heard a station you wish to talk to. Net control will come back with "The contact, go ahead with your callsign."
"Info"	You either have or wish to receive more information on a subject under discussion by net control.
"Relay"	Usually given by net control, asking for anyone who heard the calling station to relay the information to net control.
"Check Out"	Notification to the net that you are leaving the frequency (if you have requested communication with another station).
"Break, Break"	You have emergency traffic and wish immediate access to net control.

***Table 1.** Glossary.*

Net, Swedish Maritime Net and the South African Maritime Net. Twenty-one nets are listed in the ARRL Net Directory. Additionally, two highly active nets which are not listed but serve Pacific waters are the Baja California Net on 7.238.5 MHz (1600 UTC) and the Mañana Net on 14.342 MHz (1900 UTC). While most of the nets are geographically specialized, there is much overlap and boat information is readily exchanged.

How do you check in with the nets?

Monitoring the nets does not require a license and should begin as soon as equipment is available. The quickest way to learn about the nets is to monitor them for a few daily sessions. This is an easy way to pick up the jargon and get the feel of the simple standard operating procedures. Then, with your General class license in hand, you will be ready to check in with the ham maritime mobile nets. There is no one right way to do it, but it speeds things along to follow what everyone else is doing. Net control operators are a friendly bunch whose sole purpose in being on the air is to help you. Their reward is the warm feeling which comes from successfully passing message traffic and the "thank you" which follows.

Tell me about some of the individual nets

Let's examine four Pacific Ocean nets. The Baja California Net, 7.238.5, 1600 UTC, is a very informal net with coverage of southern California waters, the coasts of Mexico, and the Sea of Cortez. The net manager is Ralph Eschborn N6ADJ, of San Diego, California, who coordinates the activities of his net controllers and relay stations, and maintains the day-to-day continuity of the net. On this net, daily weather reports are given for southern California and Mexican waters.

The Mañana Net, 14.342, 1900 UTC, provides greater communications range than the Baja Net by extending to waters up and down the coast of North America and out into the Pacific. Net manager is Kermit Goettsche KB5HA, in Albuquerque, New Mexico.

The Pacific Maritime Mobile Net, 21.402 MHz, 2200 UTC, operates on a Pacific Ocean-wide basis, covering all waters from the North American Pacific coast to Asia, including parts of the Indian Ocean.

The most highly structured net is the Pacific Maritime Net on 14.314, 0530 UTC. This is a formal "roll call" net and boats transiting the oceans can request to be placed on a nightly muster sheet. Once they are placed on roll call, they are assigned a number and *must* check in when their number is called. The purpose of this net is to track boats across the pond for a safe passage. The Coast Guard is notified if boats fail to report on schedule. Boats on the roll call are required to provide initial information as to boat descrip-

tion, crew, communications capability, and destination. Daily reports include position, course, speed, wind speed and direction, and sea state.

What can we expect of the nets?

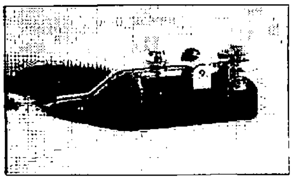
Checking in with the nets can be considered somewhat like having a mailbox in the air. Here, you can make and meet friends and talk to loved ones ashore over phone patches. For chats after making contact, it is customary (and necessary) to move to an unused frequency to keep the nets clear for additional check-ins. Most boaters who are hams consider their ham contacts as high points of the day, especially when out of their home ports for long periods.

Hams ashore keep track of all boats who do check in and most nets have an operator who maintains either a written or computerized record of boat positions. Most of the net managers, net controllers and relay stations know each other, both on and off the air, meeting in person when they can or exchanging letters. It is common to hear the same shore operators check in on several of the nets, which affords a great deal of continuity. Information is passed from one net to another and most operators know each other by voice pattern, name and callsign. Because of this familiarity, it's easy to pass messages to boats, even when the ham radio operator or equipment is not on board. Hams try very hard to get the messages through and sometimes perform near-miracles. Many messages, both routine and emergency, have been passed to boats with hams aboard, then delivered to non-ham boats by marine VHF or personal contact. Some ham boaters have had to swim over to the next boat to deliver a message. One, in particular, rowed ashore and searched hotels and trailer parks in La Paz (Mexico) before locating the recipient of a message.

Ham radio should be considered an integral part of any cruising boat's communications and navigation package. The time, money and effort spent in obtaining the license and equipment will be repaid many times over in enjoyment and usefulness.

Number 72 on your Feedback card

New Products



Celebrate Straight Key Night Right!

MFJ proudly introduces its new telegraph key. MFJ-550. It's perfect for code practice, CW sending, and, of course, Straight Key Night. It looks like a handsome black-and-chrome antique, and for just $7.95, you can hook the MFJ-550 to your transmitter and go on the air, ready to work QSOs.

The MFJ-550 comes from MFJ's Deluxe Code Practice Oscillator, MFJ-557. Thousands of hams have learned to send code on the MFJ-557, at home and in classrooms. The MFJ-557 lets you practice sending at work, at home, in your car—practically anywhere—and a volume control allows adjustment from barely audible to blaring. You can practice without disturbing anybody else.

Both the MFJ-550 Telegraph Key and the MFJ-557 Deluxe Code Practice Oscillator are covered by MFJ's *No Matter What*™ one-year limited warranty. To order, or for the name of your nearest dealer, call (800) 647-1800; write to MFJ, P.O. Box 494 Mississippi State MS 39762; or FAX (601) 323-6551. See their Web site at [http://www.mfjenterprises.com].

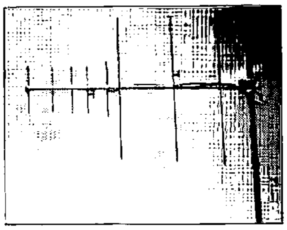
Keep It Under Your ... *Pod*?

Doppler Systems' new 6100 Series mobile DF systems, here fitted neatly into the low-visibility roof pod, uses their "AutoTrack" software program in your laptop computer. You record lines of bearing on a digital map, and a GPS receiver gives you your vehicle location and heading, which are displayed/stored on the map.

Repeat the steps as you drive, until you've closed in on your quarry.

The system is based on the DDF6100 display/processor, which uses advanced digital signal processing to estimate the bearing angle. In addition, the DDF6100 provides the data multiplexing required to interface the GPS receiver, NBFM receiver and optional compass with the laptop computer through a single serial RS232 port.

For more information, prices, and a copy of the "AutoTrack" demo disk, call Doppler Systems at (602) 488-9755 or FAX them at (602) 488-1295 in the US; Doppler's European Marketing Director can be reached by telephone or FAX at +44 1297 625690; or check out the Web site at [http://www.dopsys.com].



Dual-Band Yagi from Comet

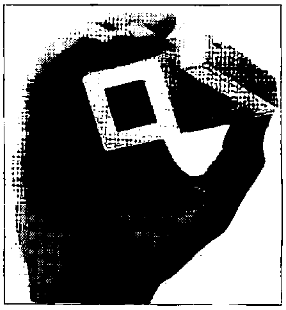
Comet has developed the CYA-240, a dual-band yagi—a new, unique design for 2m and 70cm that places the five UHF elements in front of the three VHF elements. Keeping them separate provides a superb radiation pattern.

The CYA-240 is perfect for packet, emergencies, or just to direct more output power to your contact station while reducing receive interference. It's rugged, but can be whipped together quickly for portable use, and is designed for vertical or horizontal polarization. Maximum power is 300 watts SSB, and 150 watts FM, and the Comet CYA-240's suggested price is $109.95. That should inspire you to see your dealer or contact NCG Company at (800) 962-2611. At the very least, check out their Web page: [www.cometantenna.com].

Thrills from the ARRL

The League has released a new book by Jeff Briggs K1ZM: *DXing on the Edge—The Thrill of 160 Meters*. The author, a well-known DXer and contester, has 270 countries confirmed on 160 meters, making him one of the leaders in DXing and an expert on this most challenging of the amateur bands.

The book contains a lot of "Topband" history from the beginning of operations there in the early '30s until today. Though the tales of famous 160-meter operators are entertaining, you'll also find useful information, tips and insights in it—including an audio CD with some exotic QSOs from prominent DX stations. The retail price is $29.95, in softcover. Look for it wherever you buy ARRL publications, or order it from ARRL, 225 Main St., Newington CT 06111-1494. Phone (888) 277-5289 or FAX (860) 594-0303.



Hide and Watch

The GBC CW-350 is barely bigger than a pack of cigarettes—it fits in the palm of your hand and weighs less than two ounces—but it provides maximum performance with over 425 lines of resolution and .02 lux sensitivity. It's made to be mounted easily on ceilings or walls, and it blends easily into any decor. The CW-350 comes standard with a built-in electronic shutter and 4mm wide-angle lens. Other lenses are available, as well as optional audio capability. For more information, contact CCTV Corp., 280 Huyler Street, South Hackensack NJ 07606. Call (800) 221-2240, (201) 489-9595, or FAX (201) 489-0111.

Number 74 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041-0099
[carrjj@aol.com]

Digging DX out of the noise

This month we will take a look at several different things. From time to time I like to clean out the mailbox, report on a few products, or just randomly walk through radio technology. This month we'll do just that.

I received several E-mail and postal mail requests for information on reducing noise and other signals on the ham bands in order to dig out the weaker signals (presumably weak DX signals).

Good selectivity

One of the ways that modern receivers help limit the effect of interfering signals is to provide good IF selectivity. I own a Drake R-8A receiver, and it came with switch-selectable filters of 500 Hz, 1.8 kHz, 2.3 kHz, 4 kHz and 6 kHz. I generally use one of the broader settings to home in on the signal, and then switch to a narrower bandwidth in order to copy the desired signal. This effectively blocks adjacent channel interference, but not co-channel interference.

Modern receivers also come with a couple neat features called passband offset and notch filter. The passband offset control allows you to move the IF passband small distances in center frequency in order to drop interfering signals down the slope of the IF passband curve, while keeping the desired signal closer to the center. **Fig. 1** shows the use of passband offset. In **Fig. 1A** both the undesired QRM/QRN signal and the desired signal are in the passband. Both will be heard, and copying the desired signal will be difficult. By moving the IF passband a short distance (**Fig. 1B**), the offending signal is dropped off the edge of the passband curve, while the desired signal is still in the passband.

The use of a notch filter is shown in **Fig. 2**. Again, the desired and undesired signals are in the passband together in **Fig. 2A**. By positioning the notch over the dirty, smelly bad guy signal, however, we can attenuate it considerably. This will increase the SNR considerably.

Want to null strong signals?

Radio reception is essentially a matter of signal-to-noise ratio (SNR). The "signal" is anything you want to hear, while the noise is anything you don't want to hear. And the definition of which is which changes with your goals. If you are into radio astronomy, for example, the galactic hash coming in from outer space is "signal" while the single-sideband (SSB) transmission from an exotic DX location is "noise." On the other hand, when you are trying to dig out that weak exotic DX it is the signal, and all other electromagnetic signals within the passband are noise. This includes other ham signals, lightning crashes, galactic noise, frying sounds from poor electrical connections and the whir of electric drills. For good radio reception, you need to either boost the desired signal, suppress the undesired signal, or both. Whatever it takes to get a favorable SNR. Some authorities claim that a 3 dB SNR will yield readable results, while 10 dB SNR is needed for "reasonably comfortable listening."

Over the years a number of devices have been used to eliminate the noise signal. For impulse noise (spark plugs, lightning, etc.) the old-fashioned Lamb noise limiter, diode noise clampers and noise blanker circuits have been tried. All of these circuits are more or less successful, but it's always seemed to me that the "... or less" part predominated with the noise I experienced. Besides, noise killer circuits won't do anything to rid our receivers of co-channel and adjacent channel signals (especially the loud ones).

Experienced operators agree that one of the best ways to cancel noise is to use an antenna that has a pattern with at least one null. The dipole, for example, exhibits two nulls, one off of each end. Small loop antennas, on the other hand, have a pair of nulls that are perpendicular to the plane of the loop. A small loop antenna is one that has a total wire length of less than about 0.18. Typically, from one to 10 turns on a 24-inch frame and a suitable resonating capacitor will make a loop antenna for the high frequency ham bands (obviously, more turns are needed on the lower bands).

Several designs for small receiving loop antennas can be found in my book, *Joe Carr's Receiving Antenna Handbook* (Universal Radio, 6830 Americana Parkway, Reynoldsburg OH 43068-4113, or from Book Masters at 1-800-247-6553, or Amazon Books on the Internet at [http://www.amazon.com]).

Fig. 3 shows the pattern of the small loop antenna. Note that the maxima (i.e., direction of maximum reception) occurs off the ends of the antenna, while the minima (nulls) are perpendicular to the plane of the loop. The nulls can be up to about -60 dB compared to the minima in practical antennas, although some of the theory books claim

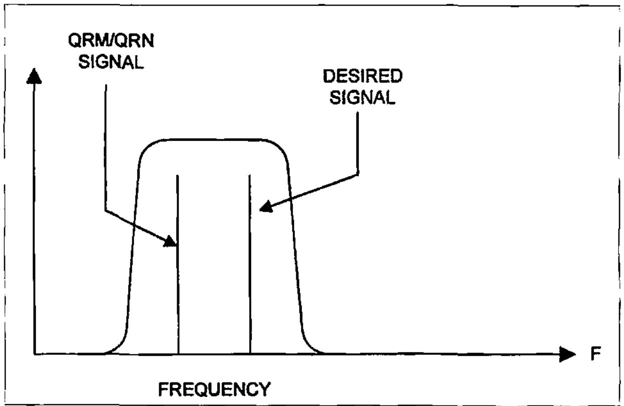


Fig. 1A. Both the undesired QRM/QRN signal and the desired signal are in the passband.

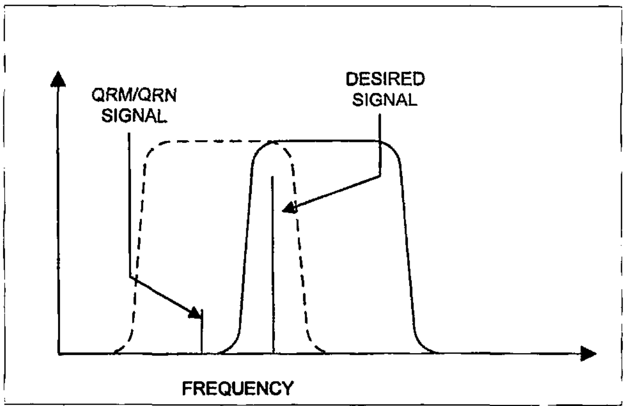


Fig. 1B. Moving the IF passband slightly leaves the desired signal and eliminates the undesired signal.

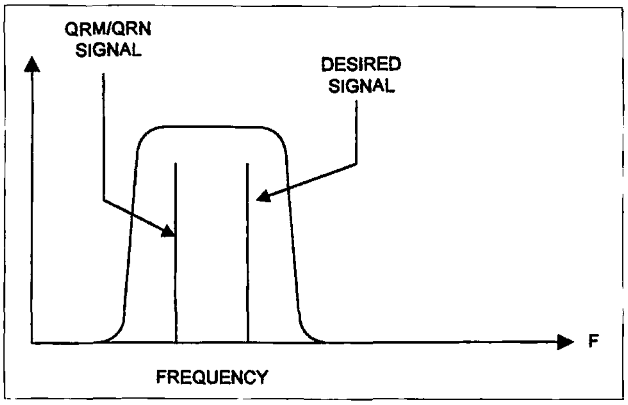


Fig. 2A. Using a notch filter.

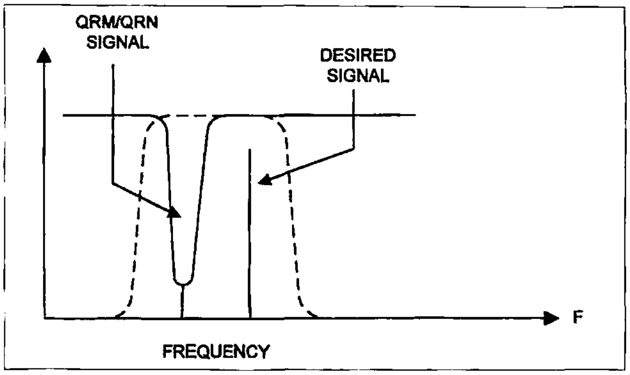


Fig. 2B. Attenuating the signal by repositioning the notch increases SNR considerably.

up to -80 dB nulls. Even a sloppy loop with a -30 dB or -40 dB null will substantially reduce interfering signals.

The idea is to position the loop so that nulls are aimed at the QRM or QRN source. Even if the maxima are not positioned exactly on the desired signal, if the sensitivity ratio between the desired and undesired signal is favorable then all is well.

Of course, if you have a large yagi or cubical quad beam antenna, then don't worry too much about small loops for receiving only ... the pattern of the beam will handle the task for you.

An active phased null antenna

MFJ Enterprises, Inc. [P.O. Box 494, Mississippi State MS 39762; 1-601-323-5869 (voice), 1-601-323-6551 (FAX), and 1-800-647-1800 (orders only)], offers a neat device that turns your station antenna into a directional receiving phased array antenna with a null up to -60 dB (see **Photo A**).

The device, model MFJ-1026, works on all modes, and at frequencies from VLF to VHF. This little active antenna and phasing control permits you to electronically "rotate" the antenna in order to place the null over a strong interfering signal. All you need to do is place the device in the transmission line between your antenna and either a receiver or transceiver. Adjust the amplitude and phase control until the offending noise signal drops in strength. The instrument sells for $119.95.

Crystal sets, anyone?

Recently I had two different readers contact me about crystal sets. I must admit to a fondness

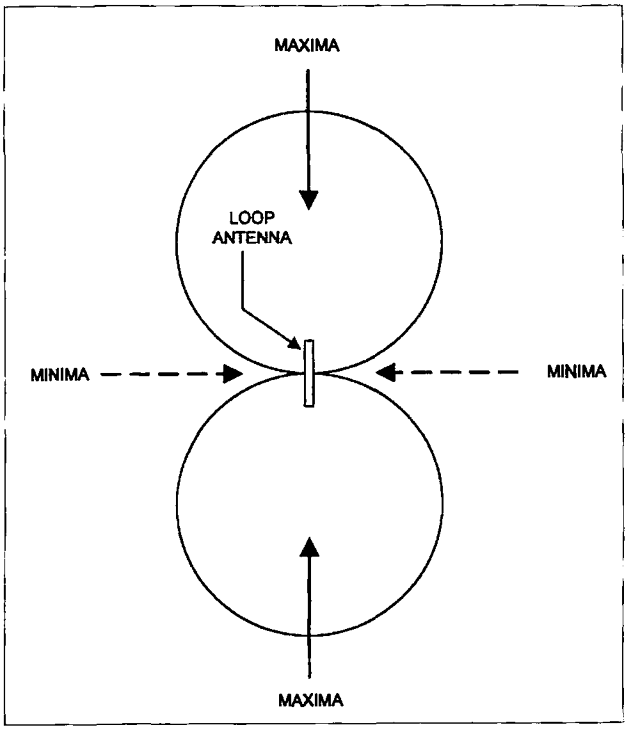


Fig. 3. Pattern of the small loop antenna.

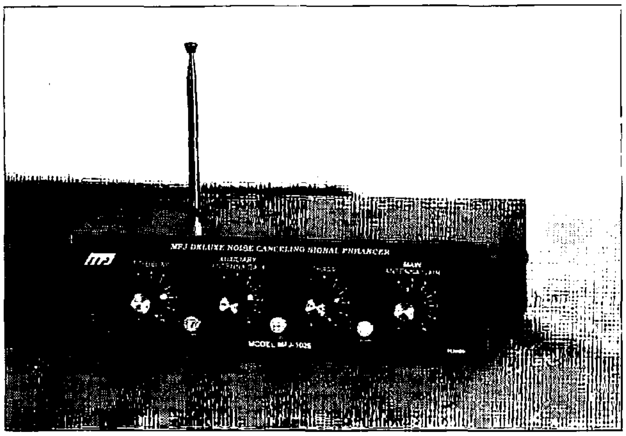


Photo A. The MFJ-1026.

for crystal sets because my first construction project in the mid-1950s was a crystal set with a "real" galena crystal. Galena is a lead-based natural mineral that has semiconductor properties (it's kind of like a naturally occurring semiconductor diode). In junior high school shop I built a crystal set based on the 1N34 diode. Unfortunately, I, lifelong smart-aleck, got into trouble with the teacher because I mouthed off when he didn't understand the idea of using a primary antenna winding of several turns over the main tuning coil to boost the signal.

Unfortunately again, I haven't had the time to pursue a dream of building the "ultimate" crystal set. This was a project that the late K4NFU (Johnnie H. Thorne) and I were going to launch one day. I would be interested in seeing any really super crystal set designs that you have. The best of them will be published in future editions of this column. Also, there is a Xtal Set Society (check the World Wide Web).

Back to school

I think I owe an apology to my computer programming students at a local community college for the amount of homework I assign. My "day job" employer sent me to 14 weeks of graduate school where I will earn 15 credit hours towards a Master's Degree in Information Systems Technology (the next 15 hours are on me!). The first week I nearly drowned in the "fire hose" we received from the professors.

It's been a lot of years since I was in a formal school, so this was a shock to my system. But maybe I won't apologize after all. If an "old duck" like me can hack it, I guess some 20-year-olds can. Besides, it's fun to give out so much work (snicker, snicker, he says, while twirling his evil mustache!).

Connections ...

I can be reached via snail-mail at P.O. Box 1099, Falls Church VA 22041, or via Internet E-mail at [carrjj@aol.com].

Number 76 on your Feedback card

Hams with Class

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Where are they now?

With almost 900 students coming through the ham radio program every term, it's an impossible task to keep track of them all. Fortunately, many of the children come back to Intermediate School 72 in Staten Island (New York) to visit the ham shack again. Those 6th, 7th, and 8th graders who get licensed tend to stay in touch with me. We plan skeds, and the kids in my classes love to speak with my former students.

It always makes me feel good, of course, when the young hams spread the word in their new schools and set up radio stations and clubs in various high schools and colleges. I've been so proud to have been invited to SAREX contacts and special events run by former students.

Eight years ago a very special young man, Shaun Gartenberg, was in my 7th grade ham radio class. He is the son of a dear friend, Marty WA2YYX. Shaun's dad had always encouraged him to get involved in the hobby, and he looked forward to getting into the school's radio program, to the friends he would make, and to the fun he would have. Shaun happened to be in a class with many other youngsters who were eager to have fun on the air with young people from all across the country.

In January, 1990, Shaun got his Novice license and began to really get involved. Shaun was in my class in 8th grade again and enjoyed working the school station to make worldwide contacts. He became a laboratory research intern at the New York State Institute for Basic Research and Developmental Disabilities in Staten Island. He worked hands-on for two and a half years in a research laboratory in the field of neurochemistry.

In 1996 Shaun became a member of the Cornell Bioengineering Society where he interacted with guest lecturers who were at the top of their field as scientists, educators, and doctors. He was also a teaching assistant for a computer science course during his sophomore year of college at Cornell University.

In January, 1996, Shaun joined the Cornell Amateur Radio Club. He participated in meetings once a week to help plan upcoming events for the club. He often works the club station and presently holds a General class license. He enjoys working CW on 40 and 80 meters and can often be heard on the NorthEast Connect on 145.250 MHz.

Shaun is a two-time winner of the Ed Ludin K2UK Scholarship from Chaverim of Delaware Valley. He won it in 1995 and again in 1997.

This year he is a winner of the ARRL General Fund Scholarship.

Shelly Gartenberg, Shaun's mother, is KB2DBF, and his sister Meredith, who was also in my

Photo A. Shaun Gartenberg KB2JNW, role model for students everywhere.

ATV

Number 77 on your Feedback card

Ham Television

Bill Brown WB8ELK
139 Angela Dr. Apt. B
Madison AL 35758

After months of preparation, an expedition from the Huntsville, Alabama, L5 Society (HAL5) set out on a 700-mile trek to Hampstead, North Carolina, to launch Project HALO (High Altitude Lift-Off). The HALO project's aim was to be the first private group to launch a rocket (carrying a live ATV system) into space from a balloon platform floating at 100,000 feet (a system known as the "rockoon").

The rockoon

The rocket itself was a unique and safe-to-handle design called a hybrid that used a fuel of nitrous oxide (laughing gas) and common asphalt. We joked that we were driving on rocket fuel as we drove down the Interstate. Several ham radio payloads were designed into the rockoon system. The command and control uplink package was built by Clay Sawyer, Ed Myszka KE4ROC, Gene Young K4ZQM and his wife Gladys. Essentially, two separate two-meter HTs on different frequencies were used to allow us to remotely uplink the rocket firing command via TouchTones™ once the balloon had carried the rocket up to 100,000 feet. This system had additional relays to allow for activation of safety cutdowns if the rocket had failed to ignite.

I designed a color TV downlink on 434 MHz that was attached to the side of the launch platform gondola to give us a great view of the rocket launch as it headed up into space. This package consisted of a one-watt PC Electronics™ KPA5-RC, a color CCD camera and an Olde Antenna Labs™ Little Wheel omni-horizontal antenna.

Ed Myszka KE4ROC and Clay Sawyer built the ATV and telemetry downlink that was carried in the nose cone of the rocket itself. Altitude information was encoded into an APRS-compatible packet format using a MIM module, a Trimble GPS board and a TEK FM transmitter on 446.00 MHz. Drogue and main chute deploy timers were also part of this package. The 1280 MHz FM ATV transmitter and amplifier (set to three watts) was designed and built by Richard Goode W8RVH and Hank Cantrell W4HTB. The rocket's camera was a miniature B/W model housed in a very rugged aluminum enclosure (model MVP5 from Micro Video Products™).

Beyond the edge of space

The HALO team gathered at the launch site in Hampstead in the wee hours of Sunday morning, May 11th. It was a very cold frosty morning with absolutely no wind. Perfect conditions for a balloon flight! The rocket crew tested out the payload and command electronics; then Al Wright and Steve Mustaikis started fueling the rocket with nitrous oxide. The balloon crew unfurled the delicate plastic envelope on the protective ground tarp, attached the Kjome™ launcher (to secure the balloon in place) and started the inflation process.

Continued on page 78

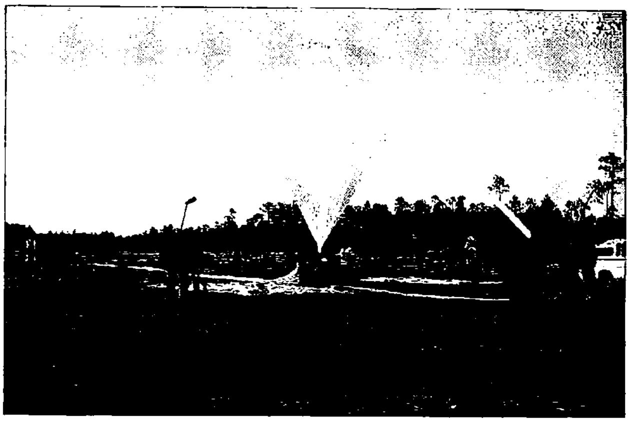


Photo A. The HALO team prepares to launch the rockoon system from a field near Hampstead, North Carolina. Photo by Ronnie LaJoie.

radio class, is KB2ZLS. Needless to say, the whole family is very proud of Shaun. He is an accomplished young man who is a credit to his family, to his community and to the hobby of amateur radio.

From time to time, I'll be featuring stories of other former students who have gone on to make their marks in the world thanks to the influence of amateur radio and the contacts they have made.

If any instructors or teachers who are readers of the "Hams With Class" column have followed the careers or lifestyles of former ham radio students, please write to me so we can share the successes of these talented young hams, and use them as role models for our students. 73

ATV *continued*

As the sun poked up above the horizon, and with just 30 minutes to go before our FAA launch window closed, Ben Frink KD4BFG (who attempted several rockoon flights of his own several years ago from Southeastern Community College—see the "ATV" column, *73*, p. 52, May 1991) discovered two nearly empty tanks of helium as he was inflating the balloon. Concerned that we would not have enough helium in the balloon to lift the rocket payload, launch director Greg Allison phoned businesses in Hampstead and nearby Topsail Beach to obtain more helium (not an easy task in the wee hours of Saturday morning).

It turned out the local Food Lion™ store had two tanks they used for party balloons, and they eventually sold them to us, after having said "No" at least three times (persistence and pleading pays off). This saved the day and allowed us to achieve final flight lift. The rocket crew lifted the payload and stretched the lines tight, the fill tube on the balloon was tied off and the call to the FAA went out for imminent liftoff. As Dr. Larry Scarborough, Peter Ewing, Ron Creel and I held the balloon launcher in place (see **Photo A**), Tim Pickens (our rocket lead) hit the balloon release mechanism with a hammer at 6:59:57 a.m. EDT. The balloon sailed off smoothly into the still morning sky carrying the rocket up on its way to the stratosphere, just five minutes before our deadline!

Spectacular color video of the balloon and the side of the rocket launch tube could be seen in the command tent. The rocket video was viewable on another monitor, but little could be seen due to the protective plastic wrap around the gondola.

The GPS telemetry, downlinked via packet radio in APRS format, started to get weak after the rockoon exceeded 23,000 feet. The signal faded completely into the noise and we were unable to record any more usable position and altitude reports from that point onward. It appeared that the final transistor of the packet transmitter had burned out.

A real blast

At 8:21 a.m., we had calculated the estimated altitude of the rockoon, based on the ascent rate, to be around 60,000 feet. I said, "Since we are now above 49,000 feet, the barometric rocket safety switches are now armed and the rocket can be fired at any time." Of course, we were hoping to reach at least 100,000 feet before firing off the rocket. Just 30 seconds later, I happened to be watching the video downlink, looking up at the balloon envelope, and thought that the balloon looked pretty full. Just then, one of the seams tore wide open, dumped out all of its helium and the balloon just folded up into a long streamer of plastic! As the rocket and gondola dropped rapidly, "Fire that rocket NOW!" I shouted to Ed Myszka KE4ROC. We had just over a minute to issue the "fire" command before

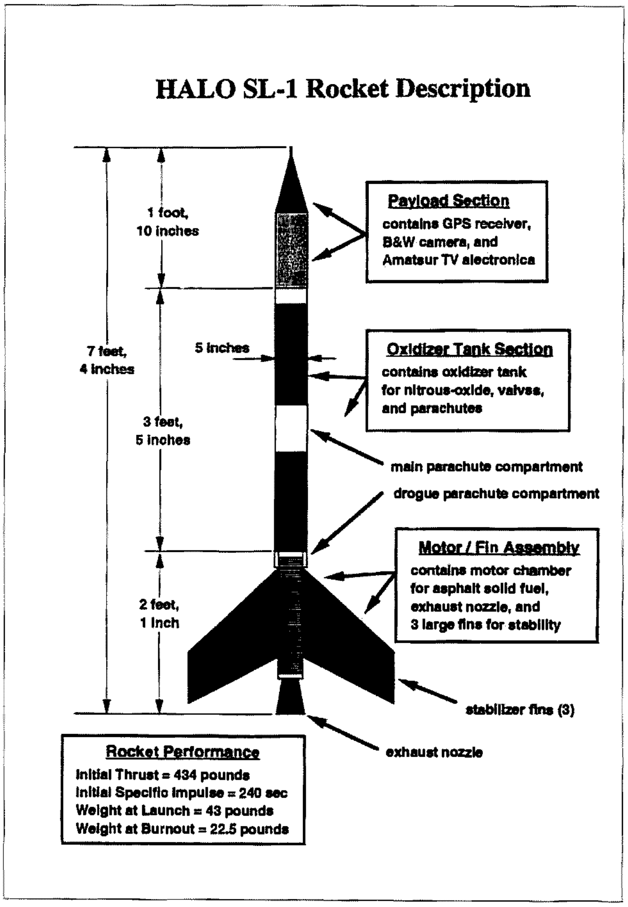


Fig. 1. The HALO rocket carried a payload with onboard ATV camera on 1280 MHz and a packet telemetry system. Drawing by Ronnie LaJoie.

***Photo B.** (l to r): Clay Sawyer and Tim Pickens finish assembly of the 7-foot, 4-inch-tall rocket. The ATV payload is just below the nose cone section. Photo by Bill WB8ELK.*

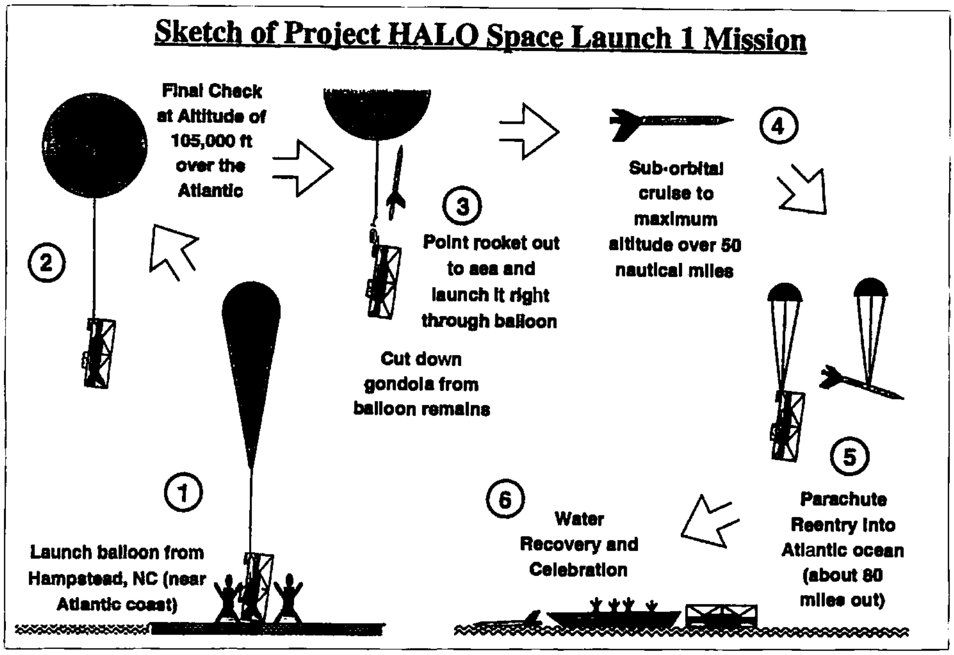


Fig. 2. Mission profile of the balloon flight and high altitude rocket ignition.

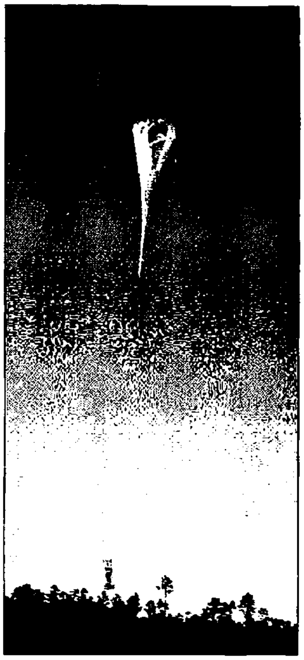


Photo C. The balloon lifts off, carrying the rocket on its way for a stratospheric launch. Photo by Ronnie LaJoie.

the safety switch disarmed the rocket at 49,000 feet.

Ed keyed down the two-meter transmitter and anxiously entered the firing code via TouchTones. Nothing happened ... he tried another time ... nothing ... and then a third (we had only seconds left before the safeties cut in). All of a sudden there was a bright flash and a cloud of smoke and the rocket leaped out of the gondola and off towards space. Bits of plastic tape and the plastic covering shredded off and fluttered past the camera view as the gondola continued its rapid descent. Miraculously, the camera had survived the rocket exhaust blast and continued to work flawlessly until the gondola splashed into the Atlantic Ocean.

We were treated to flashes of video from the rocket for about a minute, showing tantalizing views of the curve of the Earth. Since the rocket was spinning around rapidly, the ATV signal fluttered in and out and made it difficult to lock onto a good picture. After that, the video signal ceased and the rocket parachuted down into the Atlantic. We estimate our peak altitude to be between 30 to 36 nautical miles. Both the gondola and the rocket splashed down about 120 miles east of the launch site and 50 miles from the nearest land. Since the GPS signals were unavailable, we were unable to direct Bob Brandhof W3QNS who was DFing the payloads from the chase boat to an accurate splashdown location. The rocket and gondola were very small straws in an extremely large haystack and, as a result, the chase boat did not recover the payloads.

Although we did not achieve space (defined as 50 nautical miles in altitude), we did set several records: The first successful amateur launch of a rockoon (rocket launched from a balloon), the highest launch of a hybrid rocket (hybrid referring to the nitrous oxide/asphalt fuel combination), and the highest-flying hybrid rocket to date.

We hope to fly again in the next few months from the Gulf of Mexico with a larger rocket and balloon to achieve our goal of reaching space. You can follow our launch status and progress by checking out my Web page at: [http://fly.hiwaay.net/~bbrown/] or going directly to the HAL5 HALO page at: [http://advicom.net/~hal5/HALO].

Number 80 on your Feedback card

QRP

Low Power Operation

Michael Bryce WB8VGE
955 Manchester Ave. SW
North Lawrence OH 44666
[prosolar@sssnet.com]

I've just put the final touches on Ten-Tec's new 40-meter QRP transceiver. This is a dandy little rig that I'm sure will find its way into a lot of shacks. However, there are some items that need some attention.

Ten-Tec QRP modifications

Before we begin, I must mention that if you perform the following modifications to the rig, it will no longer be under warranty from Ten-Tec. Also, before you start adding or changing things around, the basic rig should be operating normally. Most of the modifications are simple to do. However, you will be required to remove the PC board from the chassis and remove components from the circuit board. Make sure you have the necessary tools for working on a double-sided PC board with plated-through holes.

Reverse polarity protection modification

This modification should be required on all portable battery-operated equipment. It's just so easy to connect a piece of gear up backwards in the field.

The modification is very simple. A diode is placed across the power jack so that during normal operation, the diode is bias-off (see **Fig. 1**). If you apply power to the rig backwards, the diode conducts and takes the fuse out. There is in fact one drawback with this design. You must have a fuse in series with the supply line. No fuse means a lot of smoke!

I used a 1N5400 series diode. The 1N5400 has a 50-volt rating, while the 1N5401 is 100 volts. Either one will work, and they are available from Radio Shack™. They are both rated at three amps, which will easily hold until your two-amp fuse blows.

This is the modification I used. It always works and you don't have to worry about damage if you connect the rig up backwards. You *do* have to have a handful of fuses on hand, though!

If you don't care for the idea of carting around a lot of spare parts, then you can still get reverse polarity protection by inserting a Schottky rectifier in series with the power source (see **Fig. 2**). The Schottky rectifier has a lower forward voltage drop than a standard silicon diode. There's enough room for you to easily add this diode from the RCA phono jacks directly to the PC board. I should mention that this diode, even though it's a Schottky diode, will still drop some voltage. Running your rig from a battery, the voltage drop will cause a significant loss of RF output.

Changing the power connector

I never did like the use of an RCA phono jack to supply power to a rig. It's not so much the connector on the rig, it's the plug attached to the wire that holds the juice that worries me. With the pin exposed, it's so easy for the plug to touch a grounded object and whoa! You've got a meltdown on your hands—another good reason God made fuses!

To keep the back apron of the rig from looking like Swiss cheese, I decided to use the original RCA jack. This time, I inserted a married pair of #16-gauge wires, terminated into a Molex™ connector, through the RCA jack. I've standardized all of my mobile/portable equipment to use the same power plug set.

About six inches of wire produces a nice "pigtail" for easy plugging and unplugging of the Molex connectors. By the way, the male end of the connector goes to the rig, the female to the power source. A terminal strip is mounted by using an existing hole on the RCA jacks. This strip holds the reverse polarity diode.

While we're at it, I placed a 4700 µF capacitor across the supply lines coming into the rig. This capacitor helps to decouple the power supply. It also helps keep transmit chirps to a minimum while using a dying battery.

Tuning upgrade

Like many of the club rigs we've seen in the past year, the Ten-Tec model uses a pot to adjust the frequency of the rig. You can smooth down the tuning rate of the rig by using a 10-turn pot. They're awfully expensive if they're new, but on the surplus market, they're not too bad. Hosfelt Electronics has a 10 k, 10-turn wirewound potentiometer for $10.

This modification is easy enough. Just remove the original unit and replace with the 10-turn

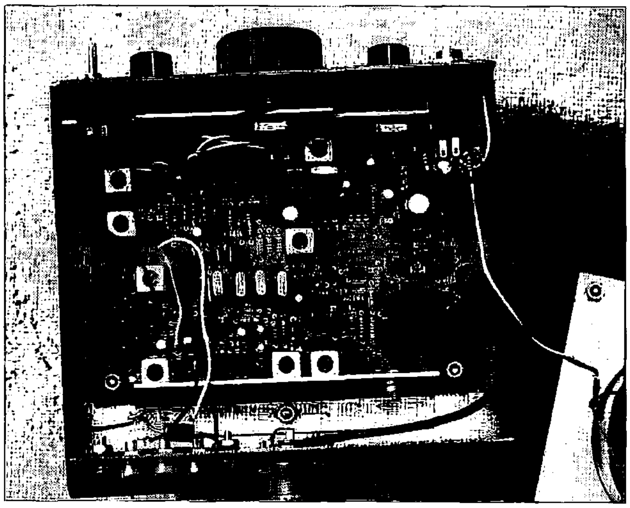


Photo A. *Inside the Ten-Tec QRP transceiver.*

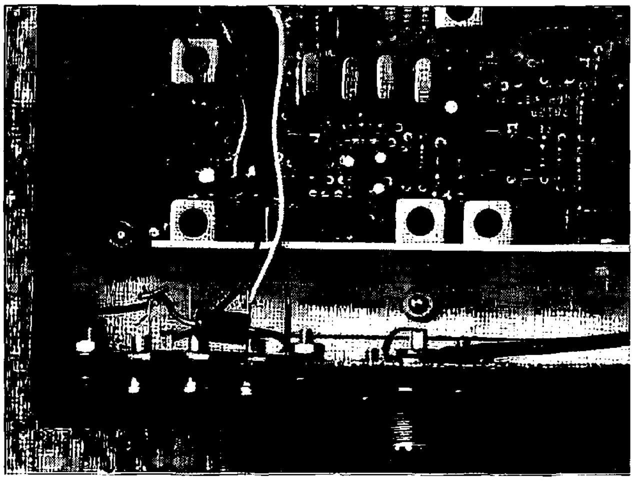


Photo B. *The reverse polarity diode is placed across the power input jack. In this photo, the capacitor the author refers to has not yet been installed.*

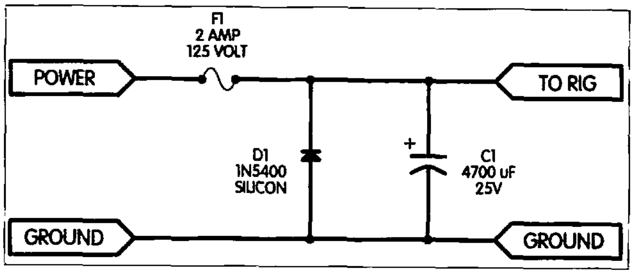


Fig. 1. Using a silicon diode for simple reverse voltage protection.

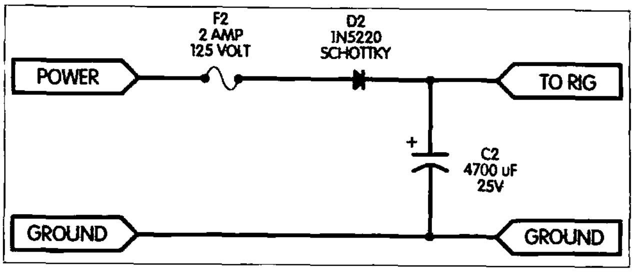


Fig. 2. Using a Schottky diode in series.

pot. Now, there is one drawback to this modification: You have no idea where you are on the band! I can live with this, since I usually just scan for stations calling "CQ" anyway.

AGC modification

While the Ten-Tec rig has a very nice AGC, it may be either too slow or too fast for your operating style. To change the time constants, I replaced the AGC capacitor with a slightly smaller value. While it would certainly be possible to do, you could add a switch and select between a slow AGC and a fast AGC. However, I'm not sure such a modification would be worthwhile.

Power-on LED

This modification is pure bells and whistles! I found I was always leaving the rig on, but with the volume turned down. A few dead gel cells later, I decided to add a small T-1 superbright green LED. Although this LED placed an additional 20-mA load on the battery, I no longer forgot to turn off the rig. The LED was placed in the top right corner of the rig. A 1 k resistor will be required in series with this LED to limit current. Tap off of the power switch on the PC board to supply the juice for the LED. A small glob of Super Glue™ or similar gel holds the LED in place. Use the jelly or gelled adhesive, not the liquid—it won't run down the back of the front panel.

Parts list

Here is a list of the part numbers I used to modify my Ten-Tec QRP rig. All the parts came from Hosfelt Electronics (call for one of their catalogs at 1-800-264-6464).

Either diode is listed by its part number, such as 1N5400, or 1N5220 for the Schottky diode. The LED part number is 25-302. 10-turn pot, 10 k, is 38-172. Hosfelt also stocks the Molex connectors. Their part numbers are as follows: plug, #03-06-2011; receptacle, #03-06-1011. You will also need the proper pins and sockets for these housings. The female crimp number is 02-06-1103. The male crimp number is 02-06-2103. While you're at it, get the extraction tool. It's worth its weight in gold if you put a pin in the wrong hole in the housing. Also, get the proper crimper to do the job. For the .062 sockets and pins, the Hosfelt Electronics catalog number is W-HT-1921. You really can't do a proper job without these crimpers.

So far, those are all the modifications I've done on my Ten-Tec QRP transceiver. I do plan on installing an S&S Engineering digital display for frequency readout. There's plenty of room on the back apron to hold a variety of add-on circuits. Perhaps a memory keyer or a Rainbow antenna tuner would be nice.

If you have any modifications for this rig, by all means send them to me. I'll print up everything that's out there.

Heathkit modifications

Also, if you have any new modifications for the Heathkit QRP rigs, the HW-7, HW-8, and HW-9, please let me know. I'm looking for just about anything for the HW-7. A while back, a reader sent me a letter asking for mods for this classic QRP rig. Seems demand has outstripped the supply, as he paid $125 for an HW-7!

The Heathkit HW-99 is a long-lost rig based on the HW-9, but with a power amplifier added. I'm looking for one of these rigs myself. So, if you've got one lying around, drop me a note. E-mail seems to work better for me since I've changed to a different ISP.

A new year

1998 is just around the corner. I'm working on some QRP test equipment. I'm not sure what it will end up as, but the project should be interesting. Also, come next year we'll do some more building and repairing of our low power rigs. And as always, if you have circuits, ideas, or anything else dealing with low power, by all means send it my way.

Hope you all have happy holidays and a grand New Year! 73

Number 82 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
[dmiller14@juno.com]

This month's column will deviate somewhat from the norm. Ordinarily I try to blend a balance of ideas, so that there exists a greater chance of there being something for everyone. This month's idea is so universal, however, that I'll be devoting the entire column to it.

Anyone who's done any amount of electronic troubleshooting will have run into a few instances where it's nearly impossible to find the defect, except by disconnecting just about everything connected across the circuit in question. That can happen when there is a dead short somewhere. No matter where you might measure, using a normal continuity tester (usually an ohmmeter), the short is registered. If a visual inspection proves ineffective, the only thing left to do is to begin disconnecting parts (or circuit branches, ugh) until the short disappears. It's generally a long and frustrating exercise. Not any more!

Thanks to Jim Wood of Santa Cruz, California, you can now track down a short in "short" order! Jim Wood's circuit originally appeared as a piece titled "'Beeper' Finds Circuit Shorts," in *Electronic Design Magazine* for April 3, 1995 (© 1995, Penton Publishing Co.), and was thereafter voted "Best of Issue." It appeared again in the October 24, 1996, issue of *Electronic Design* because of its popularity. It is reappearing here with permission from both *Electronic Design Magazine* and from the author, Jim Wood.

Jim's circuit utilizes a pair of ordinary op amps in a clever circuit that will produce a 1,000 Hz tone when the circuit's test probes are connected together (simulating a short circuit), but will quickly be lowered all the way down to a low growl or ticking sound when even a very small resistance is placed between the tips of the probes. This means that as one of the probes is moved along a printed circuit board trace that's shorted (moving toward the probe on the other side of the short), the pitch of the tone will change with even the very small resistance of the copper PC board trace itself! In fact, if you hold one probe on the wire lead of a brand-new small electrolytic capacitor (before it's mounted in the circuit), you can actually differentiate between that position and a movement of the second probe along that lead of as little as one-quarter inch or so ... just that minuscule amount of resistance is detectable.

It's easy to see why you can walk right up to a dead short using this technique, or at least get within a fraction of an inch of it. As you pass the short, the tone will begin changing again, telling you that you've gone too far. Sound like the kind of test instrument you could use?

But wait! There's more!

Using Jim's circuit in reverse will also allow you to evaluate how much resistance might be present in test leads, connector pins, ground lugs, etc., that should be close to a dead short. Anything that is supposed to show nearly zero resistance can be judged (on a relative basis) as to whether it really is making good contact. You can then clean or adjust the contacts of whatever you're measuring to see what improvement is possible. In addition to the examples just mentioned, you might want to judge how much relative contact resistance exists in a selector switch, toggle switch, relay, mechanical contactor, or other component that's supposed to have no appreciable resistive component in it. Jim's circuit is the answer.

Here's perhaps the best part ... duplicating the "Beeper" short detective is inexpensive, because all of the component parts used are readily available at any good-sized hamfest, or from the component parts dealers who advertise here in *73 Magazine* each month. Furthermore, the entire circuit is at either an audio or a DC level, so parts

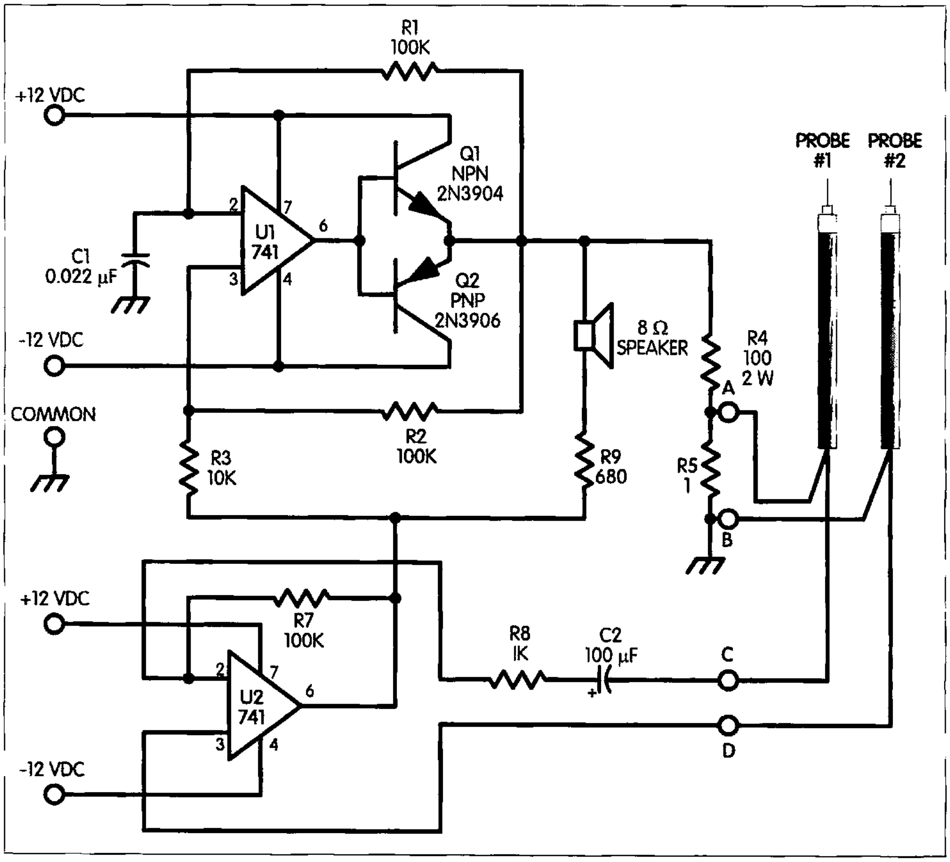


Fig. 1. The "Beeper" Short Detective circuit by Jim Wood, as originally presented in Electronic Design Magazine *for April 3, 1995, and reprinted here with permission.*

placement and wiring technique is also non-critical, as long as some reasonable care is exercised (as one would apply to any circuit where a degree of gain could potentially cause circuit instability). But it's not at all difficult to build a stable, usable unit when the parts specified are utilized. So I'd suggest that you build it "as shown" (in **Fig. 1**) first, and only then feel free to modify it if you think that you can improve upon the design for your own particular needs.

Most of the problems associated with duplicating any circuit seen in a magazine or book can be traced to not thoroughly checking over the final circuit for errors, using parts or values different from those the author suggests, or making modifications to the circuit *before* building it exactly as shown in the text. It's an error we all make from time to time. One modification that you can make that shouldn't pose a problem, however, is substituting a single LM1458 IC for the two separate LM741s. The LM1458 is simply dual LM741s in a single eight-pin DIP package that will save you a bit of board space. The pinout for this IC is shown in **Fig. 4** if you decide to take that route.

I've built Jim's "Beeper" short detective, first exactly as suggested, then modified a tiny bit, and it works like a champ!

Take a look at the original design that Jim suggested (**Fig. 1**). The "Beeper" short detective is a classic free-running multivibrator, built around a pair of the commonly available 741 op amps, but with a few important additions. Transistors Q1 and Q2 deliver a plus and minus 10-volt square wave to resistor R4 and are capable of supplying 100 mA when the probe tips are shorted together. Resistor R5 assures that the open circuit voltage never exceeds 0.1 volt when the probes are open-circuited. The gain of U2 is equal to the R4/R5 divider loss, making the two op-amp outputs identical. The tone drops to a low growl or ticking sound, effectively silencing the speaker when the probes are in the open (or high resistance) state. When the probe tips are a perfect short, however, U2's inputs are effectively shorted and the speaker will produce a 1 kHz tone. Anything between these two extremes, even a very tiny resistance, will produce a different-sounding tone, telling you immediately if you're headed in the right (or wrong) direction.

There is one precaution that must be observed. Notice that the schematic of **Fig. 1** shows two wires going to each probe ... it's important that you follow this recommendation. U2's differential input must have its own separate path to the probe tips in order to eliminate test-lead resistance from the measurement. Miniature "zip-cord"-style speaker wire makes a good two-conductor test lead fulfilling this requirement. Along this same line of reasoning, the test probe tips themselves must make very low-resistance contact with the short circuit being traced; a pair of H.H. Smith™ 317 probe-tips are ideal ... their

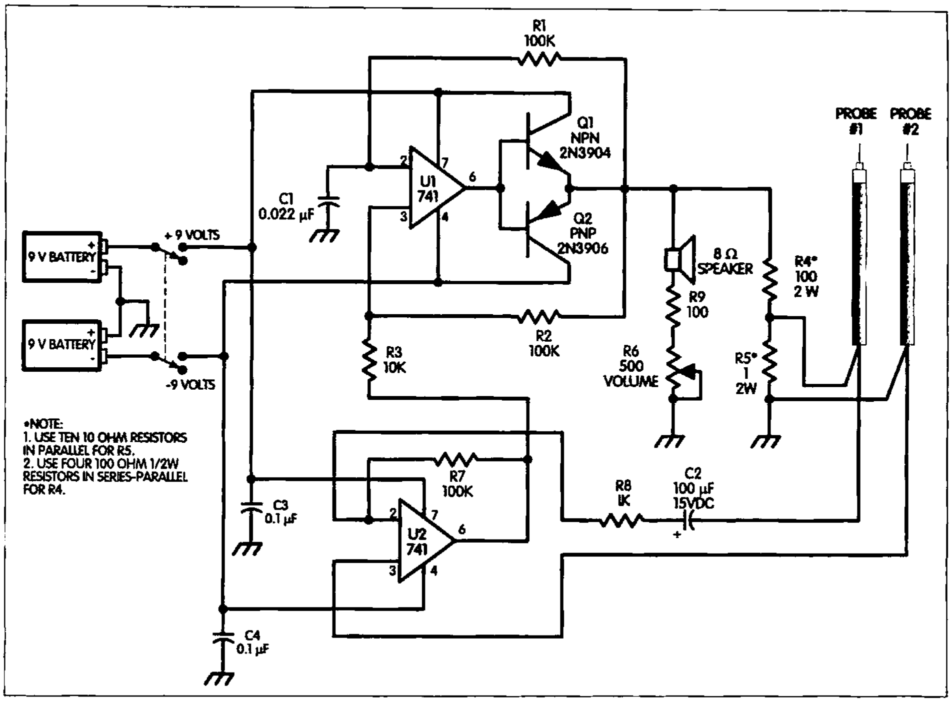


Fig. 2. NZ9E's modification.

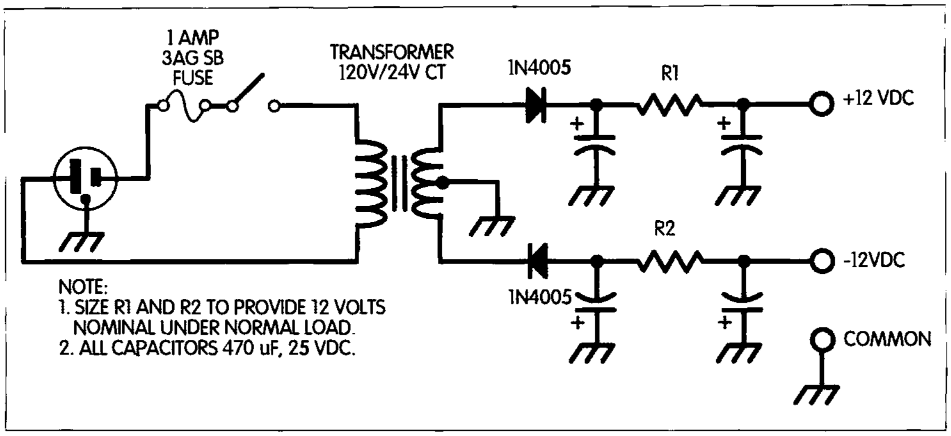


Fig. 3. Home-made dual-polarity 12 VDC half-wave power supply, suitable for use with the tester (see text).

tips are needle-sharp for piercing a wire's insulation or for digging below the flux or oxide barrier on a PC board's trace ... and they're easily replaceable as well. You can experiment with different probe tip ideas if you like—just make sure that you end up with ones having the very least contact-resistance possible.

The LM741s must also have a true plus and minus DC power source, with the common of the two supplies connected to the circuit common (illustrated as the ground symbol in **Fig. 1**). Don't let that stop you, however, because the power source requirement isn't all that difficult to meet. If you have a dual-polarity bench supply, you can simply use that. Two small 12-volt batteries could also be used. I've operated mine using just two standard nine-volt transistor radio batteries (**Fig. 2**), and except for a slight reduction in speaker volume, it works just fine. You might also want to build a simple dual-polarity supply dedicated to the "Beeper" like the one shown in **Fig. 3**. The circuitry draws less than 100 milliamperes from each supply (or battery), so the supply can be of a reasonably low current design. Even two low current wall-cube power supplies could be used—just make sure that the proper polarity is supplied to the LM741 IC's supply pins, and that the other two leads from the cubes are tied together and to the circuit common (the ground symbol).

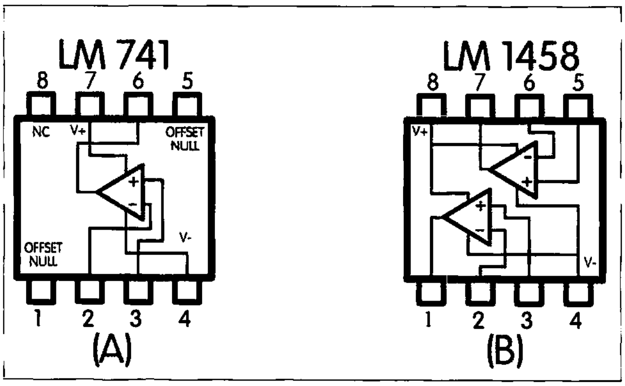


*Fig. 4. Differences in pin numbering between LM741 and LM1458 (dual 741). Note that the schematics shown in **Fig. 1** and **Fig. 2** are labeled with pin numbers for the 741 and will need to be relabeled if the LM1458 is substituted.*

Looking at the circuit shown in **Fig. 2**, you'll see a couple of small modifications that I made to mine. I used ten easily obtained 10 Ω, 1/4 W carbon film resistors in parallel for the 1 Ω resistor designated as R5 in the schematic. I also used a series/parallel configuration (of four 100 Ω, 1/2 W resistors) for the 100 Ω, 2 W resistor shown in the schematic as resistor R4. Placing all of the resistors right on the board, and wiring them as in **Fig. 2**, takes up very little additional room. I also changed R9 to 100 Ω and added a 500 Ω volume control (R6) to the speaker circuit. This affords some control over the ultimate volume level of the unit's output. I found that returning the speaker circuit directly to the common point increased the obtainable volume level a bit, especially if you're planning on using nine-volt batteries in place of the recommended plus and minus 12 volts as in Jim's original design. Again, however, it's probably best to build the circuit up originally by following the schematic of **Fig. 1** exactly, then you can begin to experiment from there. I used a socket for the 741 ICs for ease in changing the op amps if needed, and I employed a very small "flat" speaker (snapped up at a recent hamfest) for the sound output device. I built my own short detective into a Radio Shack™ 270-283A experimenter's box and perf circuit board combo. I like this combo for small projects since it incorporates both the project box and perforated circuit board (with foil pads) in one easy-to-use package. There may well be other areas in which some improvements can be made to better fulfill certain user needs for the short detective, and I'd be interested in seeing any that readers might suggest.

Fred Reimers KF9GX at FAR Circuits will supply prepared circuit boards (etched and drilled) for the "Beeper" Short Detective. All boards are made of G-10, FR-4 material, 1 oz. copper, solder-coated, and drilled. Anyone interested in building the project can order the board from:

FAR Circuits
18 N 640 Field Court
Dundee IL 60118
[http://www.cl.ais.net/farcir/]

The circuit boards are $4.25 each, plus $1.50 shipping and handling *per order*. Orders are accepted only by surface mail or FAX. No orders will be accepted via e-mail. All orders must be prepaid by check, money order, VISA or Mastercard [credit card orders will include a $3.00 service charge and may be FAXed to (847) 836-9148]. To order, please indicate the "ship to" address (orders will be shipped first class mail), home phone number, quantity of boards ordered, publication name (magazine in which the article appeared), issue date, and any other information that might be helpful in identifying the circuit board.

So that's it for this month. A very special thanks to the originator of the circuit featured:

Jim Wood
c/o Inovonics, Inc.
1305 Fair Avenue
Santa Cruz CA 95060

New game in town

I recently received a catalog from Tech America™ (a subsidiary of the Tandy Corporation™), 546 pages of electronic components

NEVER SAY DIE

Continued from page 47

money they pay for the pictures a good sound financial investment.

And that brings us down to the public (which may well include you), which shells out to buy the tabloids. This is the same curiosity that slows traffic as it goes past an accident. It's called gawking. And it's the same interest that increasingly dominates our TV news coverage. It even has a lot to do with the popularity of talk shows and *Geraldo!* interviews with weirdos. If you waste your time watching or reading this kind of crap, then you, in a way, helped contribute to Di's demise.

If, as is becoming increasingly believed by those studying death, we take our lifetime of memories with us when we pass on to whatever the next plane is, then many people are going to have a lifetime of irrelevant gawking in their memory storage, while I'll have the contents of several thousand books and conversations with experts in many scientific fields to work with "over there." As ye sow, so shall ye reap, it says in the Bible. So what are you sowing? Repent!

No, I have not yet succumbed to millennial fever, so I view with interest and amusement the many prophecies for an imminent end of the world—or, at the least, a major catastrophe which will "wipe out 90% of the world's population." So there's still time to clean up your act and start inputting stuff that will not only help you during this incarnation, but might give you an edge in the long term. When you consider the general level of laziness, it's pathetically easy to get to be an expert in almost any new field that you find interesting.

Kids

This photo of Patrick Curran KB2TNY (**Photo C**) reminded me of the first time I heard about amateur radio. I was 12 when my grandfather took me to visit a friend of his at a hotel in Bethlehem, New Hampshire. Bethlehem was a summer vacation town with 30 hotels (some huge!) and over 100 rooming houses. The son of the pastry cook (Mamie Stevenson) had a ham station in a little building out in back of the hotel. Harry W1CUN was sitting there talking to someone on 160 meters, the tubes in his final glowing cherry red. Wow! That got me to listening to 20 meters using my other grandfather's all-wave radio and collecting QSL cards from hams all around the world. How could I, even in my wildest dreams, imagine that 12 years later I'd have my own ham station in that same building, with me talking to the world?

That was right after World War II, when I got discharged from the Navy and had the summer of 1946 off before going back to college in the fall. Since our farm had no electricity and Harry had moved to Vermont, I got to use his old shack for the summer. I put up antennas all over the place, complete with a vee beam for 75 meters.

Pat was eight years old when this photo was taken and he was busy racking up grid squares on two-meter SSB. Which brings up the matter of your kids (and probably grandkids). Are you sneakily infecting their dirty little minds with the ham radio virus? Hey, anything to keep them from getting being run over on the information highway. Or have they got their own Web site already?

If you've already done your dirty deed, please sit your kid down at the rig for a photo. Help convince me that amateur radio has not degenerated totally into a hobby for middle-class elderly white men—just a way for them to mark time through those few "golden" years between retirement and their eventual incarceration in nursing homes.

L-Fields

Luck, a.k.a. serendipity, had me reading about a book by Dr. Harold Burr in the *World Research News* newsletter which seems right down your alley. That is, of course, if you have any pioneering blood left in your veins. The book, *Blueprint for Immortality*, was published, I believe, about 50 years ago.

Burr was messing around with a very sensitive voltmeter and found that all living things have electrodynamic fields which can be measured and mapped with a millivoltmeter. He called these "fields of life," or L-fields.

He found that he was able to detect when just about any part of the body wasn't working right, such as discovering cancers way before any clinical signs were detectable, just by the changes in voltage. This also turned out to be an extremely accurate way for women to determine the moment of ovulation.

The crummy article didn't say where Burr measured the voltages, just that the system worked on plants, animals and humans. I'll see if I can get a copy of the book, or at least more information about this. Maybe you can find a copy for me? In the meanwhile, let's see some articles on building millivoltmeters, and maybe some data on what you find using 'em. If you have any doctor friends, this could be an interesting and potentially valuable research project.

I'll be surprised if there isn't some connection between acupuncture points and significant voltage measurements.

Then, once we have some maps of the body's voltage fields, I wonder if there could be a reciprocal situation, where the application of a voltage might stop a developing illness? Hmm, you might want to check with an oscilloscope, just to make sure we're dealing with DC voltages.

If you stop to think about

---

and test equipment. Get your own copy by calling (800) 877-0072 or FAXing (800) 813-0087. It's well worth having in your catalog library, and if you're in Fort Worth or Denver, you can check out the Tech America walk-in stores!

The very best of Season's Greetings to everyone. Sue (KA9UCK) and I hope that your stocking is filled with all of the toys that a ham could want! Well, almost all—there's always next year! We'll return with the column more in its normal format next time, but between now and then, try putting together Jim Wood's "Beeper" and give it a try ... I think you'll like it.

Please be sure to send me any ideas that you would like to see included in this column. We will make every attempt to respond to all legitimate ideas in a timely manner, but please send any specific questions, on any particular tip, to the originator of the idea, not to this column's moderator nor to *73 Magazine.*

Photo C. *Patrick Curran KB2TNY, age 8, working some grid squares on 2m.*

NEVER SAY DIE
Continued from page 85

this, the Bioelectrifier™ and the pulse unit, we're getting more and more into medical electronics. Well, that area is far less explored than potential consumer electronic products such as digital video disks. The communications and consumer electronics fields have pretty much left us amateurs behind, but that doesn't mean we can't find areas to research which are being ignored by both industry and government for economic or political reasons.

You might want to check the books by Robert Becker on electricity and the body. They're in my book guide and I've reviewed 'em in my past editorials. And while you're at it, you really ought to check on Rawle's and Davis's work with magnets and the body. And Ott's and Lieberman's with light and sickness. All these areas of investigation are pathetically under-researched. Why? Because modern medical research is almost totally devoted to finding patentable drugs to alleviate symptoms. That's where the big money is, not in either curing people of illnesses or helping them stay healthy. And money runs the medical business, just as it does everything else.

Good luck on finding a doctor interested in working with you on L-fields, the Bioelectrifier, or the pulse unit. Let me know how you make out.

Doctors

When you get sick or break something, you go to the doctor. So do I. That's what my folks taught me and what I learned from school, the radio, movies, newspapers, and magazines. But as I've been reading, I've been getting a different perspective on the role doctors should play.

Now that I understand that virtually all of our illnesses are the result of what we've been doing to our bodies—lifestyle diseases—I can also understand why doctors are not taught much about health and nutrition in medical school. Can you even imagine someone going to a doctor and explaining that they are in excellent health, they just want to know what they should do to stay that way? You can bet that none of the medical insurance plans are going to pay for that office visit. You can also be pretty sure that your doctor isn't going to have a good answer.

If you've been to college you know that about 95% of what you "learned" is now long lost. It went into your short-term memory so you could pass your tests. Well, it's no different for doctors in medical school. Like us, they learn better by doing, and that's during their internship, where they learn to diagnose symptoms and fix broken bones.

Doctors get almost all of their information about drugs from the drug sales reps, along with paid vacations, which include a seminar on the company's latest drug. They also bribe doctors with frequent flyer miles and "research grants" to use their drugs. This starts early, with the medical student being given a stethoscope or black bag, and then later business cards and prescription pads. What the drug companies downplay are the side effects of their often toxic drugs.

Let me quote the president of the AMA: "Medical education has traditionally focused on the principles of acute episodic health-care delivery, overlooking the concepts and applications of nutrition and preventive medicine."

As I've probably mentioned too often, the more research I've done on this, the more convinced I am that virtually every illness we get is lifestyle generated. That's something to think about when you, someone in your family, or a friend, has a heart attack, stroke, cancer, or any of the chronic illnesses such as arthritis and diabetes. Oh yes, Parkinson's and Alzheimer's too. Our hospital beds and nursing homes are filled with people who have mistreated their bodies.

But can I, just using reason and endless scientific studies as a tool, get you to give up beer and pretzels? Hamburgers and fries? Frosted fruit loops for breakfast? Toaster tarts? Doughnuts and coffee? Potato and taco chips? Deep-fried onion rings? Yummmm. Hey, I like most of that crap too. On my birthday weekend Sherry, Sage (daughter) and I went to the county fair and had a fantastic time eating the most delicious onion rings in the world, a great Italian sausage sandwich (cut into three), Pennsylvania Dutch funnel cake, and other such death-defying foods. Well, we took it easy this year. In the past we also ate a bunch of fudge, barbecued chicken, ears of corn, do-it-yourself sundaes, and French fries.

But most of the time these enlightened days I eat three apples, a couple bananas, a couple ears of fresh corn (in season), a salad, a bunch of raw vegetables, and a curried chicken thigh. And I love it.

Roswell

If you are still buying the government's line that UFOs are bunk, then you sure haven't bothered to read very much. One of the best books I've found so far about the aliens (ETs, Visitors) is the recently released *The Day After Roswell*, by Col. Philip Corso (Ret.). Corso was right in the middle of things and has about as good credentials as you could ask for. He headed up the Foreign Technology desk in Army Research and Development at the Pentagon, worked for four years on the National Security Council, and so on.

In his book Corso describes the aliens recovered from the crashed ship at Roswell, as well as many of the artifacts he used to help industry R&D groups develop advanced technologies.

The ship, by the way, had no facilities for eating or waste disposal, so it was more like a scout ship and obviously had to operate from a base or mother ship.

The rash of recent TV shows with interviews of people who were there at Roswell 50 years ago, plus interviews with the children of those who were there, have all had the same consistent story. Something big and important crashed there and the Army went to a lot of trouble to try and cover it up, including scaring the wits out of the locals with threats as to what would happen to them and their families if they ever told what they'd seen.

Yes, aliens are here and have been here for well over 50 years. Yes, their technology is way the heck ahead of ours. Their ship had no controls or instruments, being operated by mind control via headbands worn by the ETs.

Obviously, if they meant us harm, they could have quickly wiped out our resistance.

With that in mind, the reports of contactees make a lot of sense, whether *The Skeptical Inquirer* likes it or not. In this case *The National Enquirer* is more in line with reality than *Skep*. Hmm, I wonder how long it's going to take for *Skep* to acknowledge the reality of cold fusion. They've been ridiculing it for years now. And that helped me lose all respect for the magazine.

The Corso book is ISBN 0-671-00461-1, runs 341 pages, and costs $24.

The next time you hear an Army or Air Force spokesman talking about the wreckage at Roswell being a weather balloon and the ETs merely dummies (which were not used in tests until six years after Roswell, by the way), you'll be laughing along with me. Oh yes, *Time* dutifully followed the Pentagon line in a recent cover article. So much for truth in our media and from our government.

Corso explained how he helped several new technologies develop—such as fiber optics, night vision, integrated circuits, and lasers—by cautiously feeding the alien technology to our scientists.

Why did Corso wait this long to spill the beans? He explains that he'd promised his general that he'd keep quiet while the general was still

Number 87 on your Feedback card

Propagation

Jim Gray W1XU
210 E Chateau Circle
Payson AZ 85541
[jimpeg@netzone.com]

Oh, how the DX rolls in when the solar flux improves! As I write (mid-September), solar flux has jumped from the sluggish 70s of the past two years to a sprightly 108, representing a 50% increase, and the DX bands have reacted accordingly. This is a good sign and may represent the hoped-for effective beginning of Sunspot Cycle 23.

The calendar shows the worst days for propagation this month (P-VP): 1st–3rd, 11th–13th, and 31st. The best days (G) should be the 19th, 20th, and the 27th. Average days (F) are likely to be the 5th–9th, 15th, 22nd–25th, and the 29th. The remaining days should show conditions trending. Don't let those Fair and trending days dampen your enthusiasm, though, because much good DX has been worked under such conditions. Rejoice! Things seem to be looking up.

10–12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15–17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the US.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30–40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar), and also short-skip during hours of darkness to 1,500 miles or more.

160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits.

Try the days marked (G) on the calendar for best results. DX toward the east until midnight, and to other areas afterwards, until dawn. Short-skip to 1,500 miles will prevail when the band is quiet.

Please remember to let me know how these forecasts are working for you. Your feedback is much appreciated. Season's greetings to our friends everywhere! W1XU.

DECEMBER 1997

SUN	MON	TUE	WED	THU	FRI	SAT
	1 P	2 VP	3 P	4 P-F	5 F	6 F
7 F	8 F	9 F	10 F-P	11 P	12 VP	13 P
14 P-F	15 F	16 F-G	17 G-F	18 F-G	19 G	20 G
21 G-F	22 F	23 F	24 F	25 F	26 F-G	27 G
28 G-F	29 F	30 F-P	31 P			

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

alive. Now, with the general gone, Corso has put the whole story in a book—and it's on the best seller list!

A Roaming ROM

If you drive around the country a lot you'll want to look into the new ARRL Repeater ROM. This $44 ROM has maps of the US and Canada and it will lay out a travel route for you showing the repeaters you can access along the way. The ARRL Repeater Directory is handier in the car, but if you are planning a long trip the ROM will lay out the details for you so you can kerchunk repeaters as you go. I hope you have better luck than I do in finding anyone alive to talk with. When I get into a town with ten repeaters I figure I'm lucky to find even one where anyone is listening. With over 600,000 licensed amateurs, and over half pretty much isolated up on two meters, how come I can't find any life on all those two-meter repeaters?

The ROM only works with PCs, so we Mac people can go fly a kite. Yes, I have a #@! PC, but I hate the damned thing.